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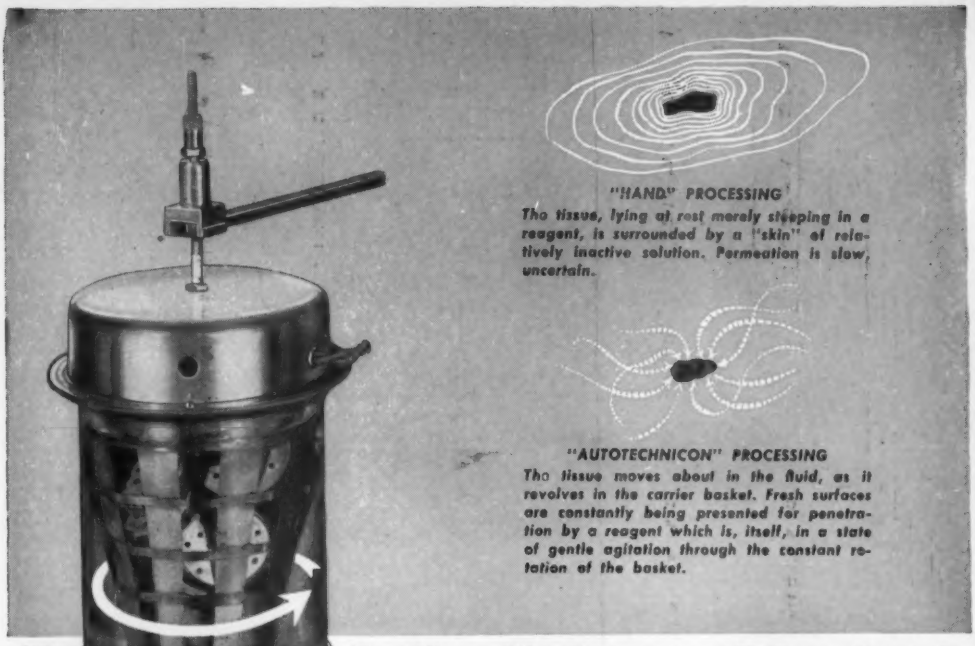

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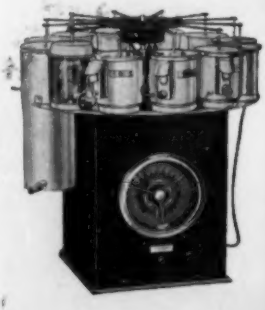

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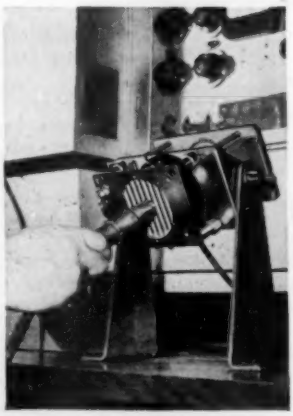

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Linguistics

LINGUISTICS has a long background of prescientific observation. The first men who thought about how speech sounded, who noticed that one utterance partially resembled another, with similar relations between the resembling parts and the rest of the utterances, or who set out to imitate the slight but systematic differences in speech of neighboring groups —all these were primitive linguistic analysts. Our biological ancestors—direct or collateral—were, by definition, human beings from the time they invented language and thereby became capable of transmitting the other systematically patterned inventions which, together with language, constitute human culture. The scientific observation and analysis of language comprise the subject matter of the science of linguistics.

Linguistics in America began with the early accounts of American Indian languages by the Spanish fathers and other pioneers. Roger Williams, among his other accomplishments, wrote a description of an Indian language, and Thomas Jefferson interested himself in the languages of the Indians. The American Philosophical Society numbered among its early members persons interested in the structure of Chinese and other "exotic tongues." For over a century the American Oriental Society has fostered linguistic studies. The American Ethnological Society and its younger sibling, the American Anthropological Association, concern themselves with American Indian languages. The associations of language teachers have always included members interested in language as such more than in literature or pedagogy.

European students became interested in the history and relationships of languages in the eighteenth century. Comparative and historical linguistics flourished especially in Germany and came to this country in the last third of the nineteenth century.

Thus linguistics in America has many roots—literary studies, philology, ethnological studies of Indians and other "primitive" peoples, historical interest in the peoples among whom Western culture developed. The Linguistic Society of America was founded in 1925, establishing its journal, *Language*. The society also participates in publishing the *International Journal of American Linguistics*, founded in 1917 by Franz Boas. An informal journal, *Studies in Linguistics*, has been issued since 1942 as an independent venture, and the Linguistic Circle of New York has published *Word* since 1945.

Boas trained his students in linguistics, as well as in other anthropological disciplines—ethnology, archaeology, folklore. His most brilliant student, Edward Sapir, trained many more, as did Leonard Bloomfield, Sapir's successor at Yale.

From 1925 the outlines of American linguistics have sharpened with the emphasis on techniques of description of linguistic systems. The analysis of the structure-points of the sound systems (phonemics) has been a primary interest. The analysis of grammatical structure, the next higher level of complexity, in terms of the forms themselves (morphemes) has occupied linguistics for some years and has recently turned to the study of the arrangements of such forms in constructions (syntax). Interest in historical and comparative matters continues, and the dialect geography of American English is being examined by the Linguistic Atlas project of the United States and Canada. In 1941, the late Benjamin Lee Whorf turned his attention particularly to the relation of language to other cultural systems—that is, the ways in which languages interact with, and influence, other things that human beings do. The second world war found linguists teaching languages, especially those little-known and previously unanalyzed.

As a full-fledged social science, linguistics interests itself in the relation of the data of language (microlinguistics) to the physical and biological sciences (prelinguistics), and in the relation of these data to other anthropological data (metalinguistics). In this last field it hopes to contribute to the investigation of many problems confronting our world culture, particularly in interpersonal and international relations, and in communication as a whole.

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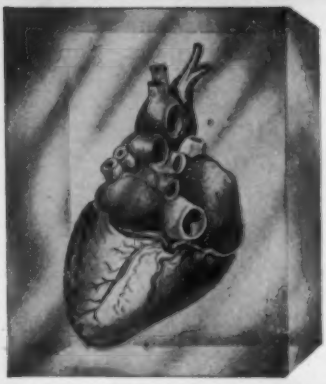

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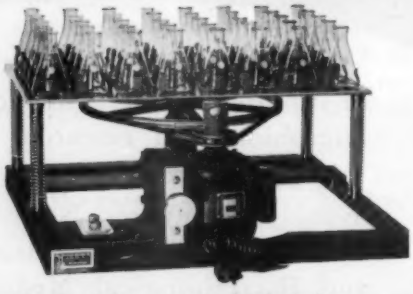

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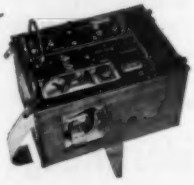

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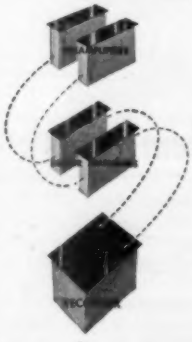

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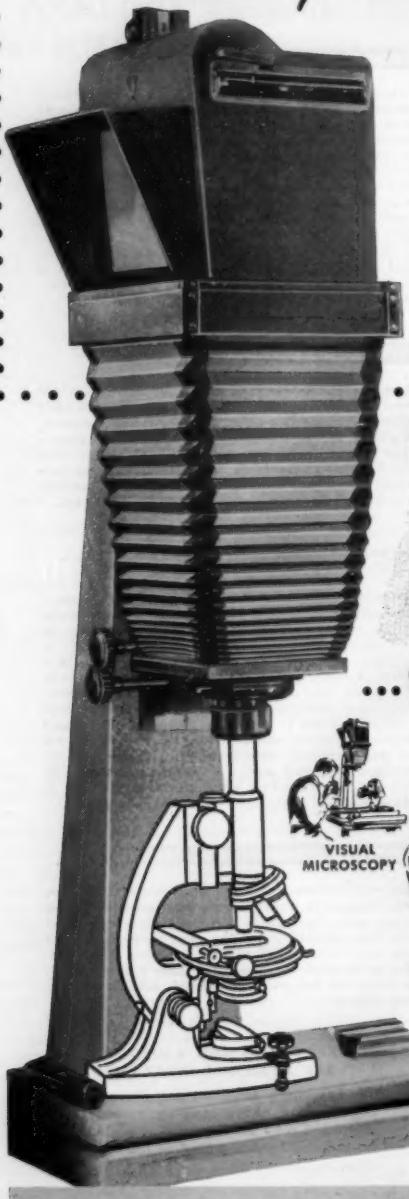

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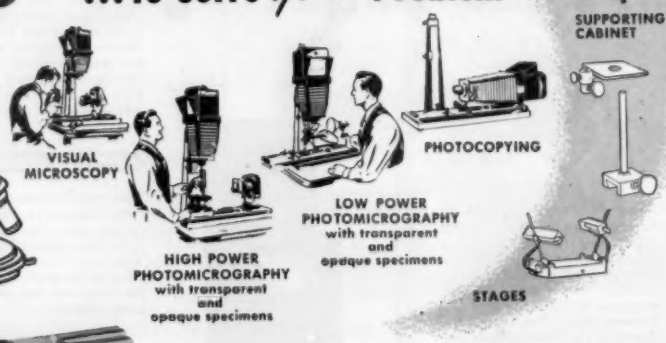

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Abstracts of Papers Presented at the Autumn Meeting, November 5–7, 1951 Yale University, New Haven, Connecticut

Placental Morphology and Fetal Respiration

Donald H. Barron, *Yale University*

To evaluate the role of the tissues that separate the fetal and maternal capillaries in the mammalian placenta in the movement of diffusible materials from the mother to the fetus, a study has been made of the conditions associated with the transfer of oxygen from the maternal to the fetal blood in the sheep, in which five tissue layers separate the two bloods, and in the rabbit, where but a single layer of cells separates the two bloods at the end of gestation. Oxygen dissociation curves of the fetal and maternal bloods have been compared, and the oxygen pressure gradients determined. The results indicate that in the sheep, with the thick placenta, the dissociation curve of the fetal blood is farther to the left relative to the maternal than that of the rabbit; further, that the oxygen pressure gradient between the maternal and fetal bloods is steeper across the thick placenta than across the thin, and finally that the coefficient of oxygen utilization is smaller in the sheep uterus than in the rabbit; i.e., of each 100 ml of oxygen brought to the placental capillaries by the blood of the sheep only about 25% is transferred to the fetus, whereas about 75% is transferred to the fetuses in rabbits at the end of pregnancy.

Haliclonasterol and Palysterol, Two New Natural Sterols

Werner Bergmann, *Yale University*

From marine invertebrates two new sterols have been isolated which possess structural features not previously encountered among natural sterols. They are the sponge product, *haliclonasterol*, $C_{28}H_{46}O$, which is isomeric with campesterol and 22,23-dihydrobrassicasterol, and the coelenterate product, *palysterol*, $C_{29}H_{48}O$, which is an isomer of β- and γ-sitosterol (clionasterol). Both new sterols are monounsaturated with the double bond in the 5,6-position, as indicated by optical evidence. Assuming the carbon skeletons of the new sterols to be the same as those of their isomers, one can deduce from a comparison of molecular rotations that haliclonasterol is like 22,23-dihydrobrassicasterol a C-24-α-methylsterol, and palysterol like γ-sitosterol a C-24-α-ethylsterol. Further consideration of optical data suggests that in both the new sterols the configuration at C-20 is the opposite of that of cholesterol and other previously known sterols. It appears, therefore, that haliclonasterol and palysterol represent a new type of epimerism among natural sterols.

Microwave Spectra of Paramagnetic Gases in a Magnetic Field

Robert Beringer, *Yale University*

Rotational energy states of paramagnetic molecules are split into their Zeeman components by a magnetic field. For fields of a few thousand gauss the Zeeman level separations correspond to microwave frequencies, and transitions from one level to another can be brought about by microwave fields. Such transitions have been studied for certain rotational states of the gases nitric oxide, nitrogen dioxide, and oxygen. The gases are contained in a resonant cavity; the transitions are observed by the absorption of energy from the microwave fields in the cavity. The method is much like that of nuclear induction experiments at radio frequencies. At low gas pressures the absorption process is highly resonant, so that good precision can be obtained in measuring the level separations and the fine details of the level structure. The measurements are of interest in the theory of the molecular Zeeman effect, hyperfine structure in molecules, and the pressure broadening of spectral lines. Good agreement with Zeeman theory is obtained for the case (*b*) molecule oxygen and the case (*a*) molecule nitric oxide. The latter also shows magnetic and electric quadrupole hyperfine structure due to the nitrogen nucleus. The experimental methods and new results are described.

Appearance and Development of Cholinesterase in the Amphibian Midbrain

E. J. Boell and S. C. Shen, *Yale University*

Unilateral extirpation of the eye from the early amphibian embryo (*Amblystoma punctatum* or *Rana pipiens*), before the formation of the optic nerve and differentiation of the midbrain, results subsequently in decreased production of cholinesterase in the optic portion of the midbrain on the side opposite that of eye removal. This is indicated not only by a reduction in the total cholinesterase content of the affected lobe, which is a consequence of its smaller size, but also in reduced enzyme activity per unit of tissue nitrogen. Under normal circumstances centripetally growing optic fibers induce the differentiation of certain neurons in the midbrain. It seems likely, therefore, that the development of cholinesterase is correlated with this process. In the operated embryo, central differentiation is incomplete in the absence of optic fibers, and cholinesterase activity is accordingly decreased. The difference in cholinesterase activity between the normal and affected optic lobes gives an indication of the relative proportion of nerve cells in a given volume of tissue whose differentiation depends upon optic fibers.

As development proceeds, the difference in cholinesterase activity between normal and affected midbrain lobes becomes progressively lessened. This probably results from the invasion of the midbrain by nonoptic fibers, especially from more posterior levels of the central nervous system, and the consequent physiological and biochemical maturation correlated therewith. That cholinesterase development appears to be a fairly specific indicator of neuron differentiation is shown by the finding that succinoxidase activity of the midbrain is unaffected by eye extirpation.

A Classical Dynamics View of Gauge Invariance

G. Breit and R. L. Gluckstern, *Yale University*

By employing a generalization of the Hamilton principal function W to a functional of field variables one can connect conservation of charge and the validity of Poisson's equation with gauge invariance (GI) in a systematic manner. The infinitesimal gauge transformation defines an infinitesimal contact transformation in the sense of classical dynamics. It is shown that the associated classical integral of motion has, as a consequence, for GI of the first kind conservation of total charge, whereas GI of the second kind with a time-independent gauge implies Poisson's equation with an arbitrary additive time constant charge density. The discussion has the same form, independent of the number and kinds of particles. The reasoning shows that if Poisson's equation holds as above then the associated nonquantized field Hamiltonian is gauge-invariant. One sees that the point character of field matter interaction is essential for the theorem and its inverse. The proof applies to relativistic and nonrelativistic Hamiltonians, including radiation. The current four vector can therefore be defined within an additive constant charge density, and the question of exchange currents derivable from GI considerations does not arise, as is natural in any formulation pretending to specify all interactions.

The Isoenergetic Point of Dyes

L. G. S. Brooker, *Eastman Kodak Company*

"Isoenergetic" implies that situation where the two extreme resonance structures of a dye have the same energy. Applied to dyes in solution, it is of particular significance for nonionized dyes such as the *merocyanines*, which resonate according to the scheme

$$>\mathrm{N}-\overset{|}{\mathrm{C}}(=\overset{|}{\mathrm{C}}-\overset{|}{\mathrm{C}})_n=\mathrm{O} \longleftrightarrow > \overset{\oplus}{\mathrm{N}}=\overset{|}{\mathrm{C}}(-\overset{|}{\mathrm{C}}=\overset{|}{\mathrm{C}})_n-\overset{\ominus}{\mathrm{O}}),$$

for here the relative energy of the extreme structures is strongly dependent upon the choice of solvent. In the merocyanines the dipolar resonance structure is frequently of unusually high stability, and if such a dye is dissolved in a strongly polar solvent the dipolar structure may become so highly stabilized that it will have by far the lower energy of the two. The consequent energetic asymmetry of the extreme structures causes such dyes to absorb at much shorter wavelengths in polar than in nonpolar solvents, formerly an infrequent phenomenon. For certain of the merocyanines successive additions of small amounts of water to a solution in anhydrous pyridine cause a sharp rise in ε_{max}, though λ_{max} is also slightly affected. At a given point ε_{max} and λ_{max} reach maximum values; further increase in the water content of the solvent causes an abrupt inversion in behavior, ε_{max} now falling sharply and λ_{max} moving to shorter wavelengths. The ε_{max} vs. λ_{max} curve gradually levels off until in the neighborhood of pure water, λ_{max} is much more sensitive to a change in solvent composition than ε_{max}. It is assumed that the apex of the ε_{max} vs. λ_{max} curve, the point of inversion, corresponds to the isoenergetic point; either increasing or decreasing the polarity of the solvent mixture at this point brings about energetic asymmetry of the extreme structures, the immediate result of which is a sharp drop in ε_{max} with, later, a reduction in λ_{max}. With solvent-sensitive dyes such as merocyanines a continuous change in the energy difference between the extreme structures is thus brought about by a continuous change in the environment (solvent) rather than by a series of structural changes such as has been studied in ionized dye series.

A New Discussion of the Changes in the Earth's Rate of Rotation

Dirk Brouwer, *Yale University*

Observations of the moon since early in the seventeenth century show that during the past three centuries the earth has at times been behind and at times ahead of uniform rotation by amounts up to about 30 sec. The cause of these fluctuations is still unknown.

An analysis of the more accurately known part of the fluctuation curve, since 1820, shows that if the derivative of the curve is plotted against time, a set of straight-line sections is obtained, changes in direction taking place with intervals between 4 and 15 years.

Theory shows that random changes of this character produce an amplitude of the fluctuation curve that increases with the power $\frac{3}{2}$ of the time before or after the present epoch. A comparison of the tables of the moon's motion with eclipse observations going back to 700 B.C. confirms this conclusion.

This result has an important effect on the evaluation of the rate of retardation of the earth's rotation. In previous discussions older observations were given too much weight, proportional to the fourth power of the time interval, which must now be changed to the first power of the time.

A provisional discussion indicates that the new solution will lead to a lesser rate of retardation than had been considered established. However, there is need for a complete revision in which, in addition to the modern material, all reliable older observations should be included, from the oldest known records to the invention of the telescope.

Microbiological Studies on the Intrinsic Factor of Castle

Paul R. Burkholder, *Yale University*

Methods for the preparation and assay of the activity of concentrates of intrinsic factor which binds vitamin B_{12} have been developed. Bacteria isolated from jejunal juice of Addisonian anemia patients were found to have a strong tendency to absorb vitamin B_{12} from solution. The so-called intrinsic factor prevented quantitatively the consumption of vitamin B_{12} by these bacteria. A mutant of *E. coli* was employed to determine the unabsorbed amount of vitamin B_{12} released by heat from its binding to intrinsic factor. Thus the amount of vitamin B_{12} protected by intrinsic factor could be assayed. Numerous bacteria present in the upper gastrointestinal tract of anemic patients were shown capable of absorbing large amounts of vitamin B_{12} in the absence of intrinsic factor.

Various procedures for extraction and concentration of intrinsic factor were carried out, and it was found that considerable concentration of the material could be achieved by enzymic digestion of an aqueous extract of fresh hog gastric mucosa, followed by precipitation of the factor with zinc-ethanol reagent or with ammonium sulphate.

Some evidence was obtained showing that saliva of the Addisonian patient may contain intrinsic factor activity which may be destroyed by the patient's gastric juice.

This action may be prevented by the addition of acid to the gastric juice before incubation with saliva.

These studies add further evidence to support the theory that typical Addisonian anemia may be caused by removal of vitamin B_{12} from the patient's digestive tract by the microbial flora under conditions of achlorhydria.

Electron Exchange-Resins

Harold G. Cassidy, *Yale University*

We have set up the hypothesis that high polymeric materials may be synthesized which are able to undergo electron exchange in a suitable medium in a manner analogous to the exchange of protons by cation exchange-resins. Such substances have been prepared. Their properties are discussed, and it is suggested that we have in these substances the possibility of constructing models of enzyme systems.

Biochemistry and Biomechanics of Blood Collection, Processing, and Analyzing

Edwin J. Cohn, James L. Tullis, Douglas M. Surgenor, William H. Batchelor, and Maurice D'hont

University Laboratory of Physical Chemistry Related to Medicine and Public Health, Harvard University

Further developments render possible reduction in the size of equipment and the time of processing to stable states of blood cells and plasma proteins. The Mobile Blood Processing Laboratory, on a 32-ft refrigerated trailer truck a year since, is now portable and can be completely mechanized.

Replacement of formed element sedimentation and cup centrifugation by newly devised, light, low-speed, continuous centrifugation in a closed system of nonwettable surfaces, and of over-all refrigeration by heat exchange, yields cell-free plasma at the desired low temperature at the time and at the same rate as blood leaves the vein of the donor.

The subzero ethanol-water system has been largely replaced by an aqueous system, and classical electrochemical interactions by specific interactions of metals and sugars with cells and proteins, believed to be more closely related to those of nature.

Red and white blood cells, platelets, prothrombin, isoagglutinins, γ-globulins, α- and β-lipoproteins, fibrinogen, metal-combining protein, and albumins may be separated from each other in a continuous operation in a closed sterile system and preserved under the best known conditions for transfusion. Modifications of the process render it useful in reclaiming for transfusion the stable proteins in outdated blood, and for analyzing fresh blood for any of the above, as well as for other protein, protein enzyme, steroid, or polysaccharide components.

On Finite Groups with Two Independent Generators

Jesse Douglas, *Columbia University*

Although the theory of finite groups is a well-worked branch of mathematics, the study of the topic designated by the title, in its full generality, seems not to have been hitherto undertaken. The key idea is to introduce a certain pair of conjugate substitutions θ, φ of a special nature; these determine the group structure completely, and their investigation furnishes all the properties of the group. Specifically, the substitutions $x \rightarrow \theta(x)$, $y \rightarrow \varphi(y)$ are defined by the formulas: $BA^{\alpha} = A^{\theta(\alpha)}B^{\psi(\alpha)}$, $B^{\beta}A = A^{\omega(\beta)}B^{\varphi(\beta)}$, where A, B are the independent generators.

If the group is abelian, θ, φ reduce to the identity, and conversely; but practically all the interest resides in the noncommutative case: $BA \neq AB$. Dihedral groups, $A^m = 1$, $B^2 = 1$, $BA = A^{-1}B$, are a very special example.

Multiple Congenital Abnormalities Resulting from Acute Folic Acid Deficiency during Gestation

Herbert M. Evans, Marjorie M. Nelson, and C. Willet Asling

University of California

Previous studies (by Nelson and Evans) have shown that an acute folic acid deficiency may be instituted in normal rats (by using a specific vitamin antagonist, x-methylpteroylglutamic acid, with a purified diet containing succinylthiazole) on the day of breeding or as late as 9 days after breeding, with the invariable occurrence of fetal death and resorption. In contrast, delaying the deficiency to the 11th day resulted in virtually 100% litters, although all young were dead at birth and showed multiple congenital abnormalities. When these young were removed by Cæsarian section one day before parturition, they were living as judged by heartbeat and reflex movements, although the lungs would not expand and were markedly translucent in appearance. The kidneys were minute, pale structures, markedly subnormal in development. Cleft palate and syndactylism were obvious macroscopically. Cleared alizarin-stained specimens revealed general retardation in skeletal growth and maturation, together with deformed, misshapen bones and the absence of certain ossification centers.

A transitory folic acid deficiency for 3 days (day 11–14 or 10–13) resulted in young with syndactylism, cleft palate, and facial deformities, more marked in the latter group. A 2-day deficiency period (day 10–12) added harelip and polydactylism to the previously mentioned abnormalities. An earlier period of deficiency (day 9–11) resulted in facial, cranial, and eye abnormalities and umbilical hernias, but no digital deformities. A less acute vitamin deficiency from day 7–9 showed the most marked cranial abnormalities yet encountered, including hydrocephalus, exencephalus, and anencephalus, together with eye abnormalities and abdominal herniations.

These congenital abnormalities strikingly resemble the skeletal and eye abnormalities reported for maternal riboflavin and vitamin A deficiencies (Warkany *et al.*), respectively, and the cranial abnormalities from B_{12} deficiency (Hogan and Richards) and pantothenic acid deficiency (Boissilot). It thus appears that developmental normality is dependent on manifold biochemical mechanisms, and that strikingly similar malformations flow from interference with any one of the underlying mechanisms during the "critical" developmental periods.

Suppressor Genes and Heterosis

Herbert L. Everett

The Connecticut Agricultural Experiment Station

Heterosis is the increased vigor often exhibited by hy-

brid individuals. Previous studies utilizing *Zea mays* as the experimental organism have indicated that this increased vigor may be brought about through the accumulation of favorable dominant alleles of hybrid gene-pairs. Vigor may also be achieved through the combined actions of these heterozygous alleles where the homozygous action of each allelic pair is reduced in comparison with the action of the hybrid or heterozygotic pair. Data have been obtained which suggest a third possible basis for heterosis. Suppressor genes nullify the effects of mutated major genes and in corn have been shown to represent a range of reactions from partial to practically full duplication of a major gene for chloroplast pigment production. In this case a mutation to albinism may be returned to pale green by one suppressor gene, or to normal green by a second suppressor gene. Isolation of the diverse genic combinations has been accomplished, and their isolated and combined effects on plant productivity as well as on plant pigments have been observed. On a biochemical basis, it may be suggested that suppressor genes in combination with nonmutated major genes permit alternate enzymatic pathways. When hybrid gene combinations result in complete chains of these alternate pathways from substrate to end product, a maximum response of the organism to its environment is allowed, and this maximum response results in heterosis.

Evidence of Climatic Fluctuation Common to North America and Europe

Richard Foster Flint, *Yale University*

The Two Creeks peat layer, exposed in southeastern Wisconsin, records through its fossil-plant content a cold-temperate climate. It lies between two sheets of glacial drift. The Alleröd peat layer, exposed in many parts of Europe, records a temperate climate preceded and followed by colder climates. It, too, overlies a glacial deposit.

Dating of several samples of both peat layers by Libby and Arnold, using the radiocarbon method, has established with high probability the age equivalence of the two peats. If contemporaneous, the peats are a product of a single warm climatic fluctuation that occurred between two glacial times and that was common to both North America and Europe.

The alternating sequence of glacial and nonglacial layers within the fourth, or latest, glacial stage in Europe is strikingly similar to the sequence in North America. Furthermore, the Two Creeks–Alleröd peat occupies the same relative position in both sequences. It is therefore probable that a single series of climatic fluctuations has affected both continents simultaneously.

The Effect of Ionizing Radiation on the Transforming Factor of Pneumococci

Donald J. Fluke, Ruth M. Drew, and Ernest Pollard
Yale University* and *Brookhaven National Laboratory

Dry preparations of the transforming factor of pneumococci have been found to be sufficiently stable to permit deuteron and electron bombardment. The measurement of activity is in terms of the ability to convert rough type to Type III pneumococci. Deuteron bombardment gives a semilogarithmic inactivation which yields a cross section related to the area of the molecule. Electron inactivation is similar and yields a volume which may be presumed to be the volume of the molecule.

It is found that the factor is highly sensitive to ionizing radiation, and from the combined results of deuteron and electron bombardment our data fit reasonably well with a molecule of weight 18,000,000 and an axial ratio which is around 40: 1.

At liquid air temperatures the cross section for deuteron bombardment is considerably less. This shows that a nucleic acid cannot be characterized by lack of thermal sensitivity in its radiation effects.

Polarization of Bremsstrahlung Radiation

R. L. Gluckstern, M. H. Hull, Jr., and G. Breit
Yale University

The polarization of the γ-rays produced in Bremsstrahlung has been investigated in order to see whether this process may be useful in producing high-energy polarized radiation. The calculation was performed by evaluating the matrix element of the radiation field between the initial and final states. Electron states were computed by the first Born approximation. However, the arrangement of the calculation lends itself to the use of exact electron wave functions. The differential cross section for the production of γ-rays with polarization vector $\mathbf{1}_s$ is

$$d\sigma = 2\left(\frac{Ze^2}{2\pi mc^2}\right)^2 \frac{p_f d\varepsilon_f d\Omega_f d\Omega_g}{137\, p_i g q^4}\left|\frac{p_{fs}{}^2[ii]}{\varepsilon_f{}^2}+\frac{p_{is}{}^2[ff]}{\varepsilon_i{}^2}-\frac{2\,p_{fs}p_{is}[fi]}{\varepsilon_f\varepsilon_i}+\frac{g^2}{\varepsilon_f\varepsilon_i}\left[q^2-(\varepsilon_f-\varepsilon_i)^2\right]\right|,$$

where

$$\mathbf{q}=\mathbf{p}_f-\mathbf{p}_i+\mathbf{g}$$

and f, i refer to final and initial states, respectively. The notation is

$$\varepsilon_a = E_a-(\mathbf{p}_a\cdot\mathbf{g})/g,\ (a=i,f);$$
$$[ab]=4\,E_aE_b-q^2;$$
$$p_{as}=(\mathbf{p}_a\cdot\mathbf{1}_s).$$

Energies E are in mc^2, momenta p, g in mc, p and E referring to electron, g to photon.

Averaging over polarizations, one obtains the Bethe-Heitler formula.

Nuclear Isomers and Shell Theory

M. Goldhaber, *Brookhaven National Laboratory*

When a nucleus remains in an excited state for a considerable time it is called an isomer. Isomers occur in "islands," close to the "magic numbers," which shell theory can explain. They correspond to the closing of shells and therefore to particularly tight binding of nuclei. Near the end of a shell, states of very different angular momentum are adjacent. The γ-transitions between such states are highly forbidden; hence isomers exist there.

The Production of Extensive Artificial Clouds for the Study of Precipitation Mechanics

Ross Gunn, *U. S. Weather Bureau*

With the object of bringing clouds into the laboratory for study and quantitative evaluation, a shaft $200 \times 2.5 \times 2.5$ m has been prepared that permits the cooling of its air by sudden expansion. Clouds more than 200 m deep may be produced under controllable conditions, and their

behavior determined. The shaft and its auxiliaries are described, and the problems of cloud production, control, and stability in the laboratory are discussed.

Basic methods for measuring evaporation and growth of water droplets falling freely down the shaft are described and actual records shown.

Effect of Bilateral Destruction of Frontal and Posterior Association Areas on Learning by Monkeys

Harry F. Harlow, *Department of the Army*

The behavior of four normal rhesus monkeys and four rhesus monkeys with extensive bilateral lesions in both the frontal and the posterior association areas was compared on a series of standardized learning tests carried out over a period of a year. The eight monkeys had previously been continuously tested for a 5-year period, and their training history had been maintained for the same period. During the five years the operated monkeys had undergone two brain operations; a third operation produced the above-described preparation.

The test battery included patterned string tests, discrimination tests, discrimination-reversal tests, delayed reaction tests, and oddity tests. In spite of the magnitude of the lesions there were no significant differences in the performances of the two groups on either the discrimination or the discrimination-reversal tests. Significant differences could be demonstrated between the two groups on complex delayed reaction tests but not on simple, 5-sec delayed reactions. Significant differences between normal and operated monkeys on selected string tests could be demonstrated. Consistent, highly significant differences were found between the normal and operated monkeys on the oddity problems. Only on the oddity test was there no overlapping of performances between individual subjects of the operated and control groups.

The data of these experiments show that highly trained animals with very extensive brain damage may perform on discrimination tests at a level of efficiency which would be attainable by normal monkeys only after many hundreds of trials. The solution of such complex problems as oddity and complex delay appears to be adversely affected by very extensive cortical lesions, but even in the case of these problems the degree to which exprience may compensate for cortical destruction is striking.

Species Differences in the Stimulus Value of Equivalent Habitat Temperatures

L. P. Herrington
Yale University* and *the John B. Pierce Foundation

Concentration on the temperature of minimum metabolism under basal conditions for different species has been of great importance in demonstrating common principles of heat regulation in homoiothermic animals. In the laboratory habitat and under strict basal conditions, many domestic animals and common laboratory reagents have points of thermal neutrality that lie within a very narrow temperature range. In their natural habitats, however, animals differing in mass, in degree of peripheral insulation, and in plane of nutrition experience notably different degrees of thermal stimulation from seasonal and diurnal temperature cycles of a physically standard character.

In the temperature habitat, the slow insulative and nutritional adjustments to such temperature cycles represent a compromise between the adjustments most efficient for continued heat stress and those most efficient for a continued cold stress. By utilization of the principles of partitional calorimetry, measurements of peripheral insulation in combination with metabolic data and coefficients of external heat loss may be used to calculate the environmental temperature which requires minimal temperature regulation under natural conditions. The species-specific neutral temperatures found by such studies are distributed over a very much wider range than the comparable temperatures of thermal neutrality as determined under strictly basal conditions.

Application of this technique to data for three species is illustrated, and the biological meaning of the resulting temperature levels discussed. From the standpoint of general biology, such data are of interest as a step toward the construction of a biological scale of temperature which would emphasize biophysically conditioned species differences in the stress imposed by a cyclic habitat temperature. Such a scale, through the incorporation of factors for heat production, optimal insulation, and body mass or thermal inertia, would provide a basis for determining the different physical temperature cycles required to provide equivalent thermal stimulation for different species. In the absence of such a scale, no inter-species comparisons of endocrine or metabolic reactions can be said to be fully controlled with respect to the important stimuli associated with cyclic temperature changes.

Proton Groups from the Deuteron Bombardment of Vanadium

D. C. Hoesterey, *Yale University*

The energy distribution of protons from the reaction V^{51} (dp) V^{52} has been studied using 3.80-mev deuterons from the Yale University cyclotron. Observations were made at 90°, using aluminum absorber and a peaked proportional counter. Three groups are in evidence with Q values of 6.25, 5.73, and 5.40 mev, corresponding to the ground, first excited, and second excited states, respectively. This gives two levels at 0.52 and 0.85 mev above ground. From the ground state Q value the mass of V^{52} is 51.9568 mu.

Factors Influencing the Rate of Forgetting of Communicated Material

Carl I. Hovland, *Yale University*

In their book *Experiments on Mass Communication*, Hovland, Lumsdaine, and Sheffield reported changes in opinion following communications which do not conform to the classical curve of forgetting. Opinion changes were in some cases actually larger after a time interval than immediately after the communication. One hypothesis suggested was that the subjects may have been suspicious of the communicator and therefore initially refused to accept the position advocated; after an interval they may have forgotten where they learned the material but remembered the content. This might then have produced a greater shift in opinion after a lapse of time. This hypothesis was tested as part of a systematic program of research on motivational and emotional factors affecting the acquisition and retention of information, opinion, and attitude. In the first study, by Hovland and Weiss, identi-

cal communications were used but attributed to sources of varying credibility. Opinion changes derived from "trustworthy" sources showed typical "forgetting." Opinions were less affected initially when presented by "untrustworthy" sources, but the extent of change *increased* with time. These results, together with data from related experiments of Weiss and Kelman, appear to indicate that typical forgetting does occur for opinions derived from communications, but that there is superimposed on the forgetting pattern a "discounting" factor for material presented by untrustworthy sources. This "discounting" diminishes with the passage of time, producing a net increase over time in the extent of agreement with an untrustworthy communicator. Theoretical implications of the results are discussed.

Influence of Bilateral Adrenalectomy, Adrenocorticotrophin, and Cortisone Acetate on Certain Human Tumors

C. Huggins and Delbert M. Bergenstal
University of Chicago

Bilateral adrenalectomy in man can now be done with comparative safety (14 consecutive cases without fatality) as a result of refinements in surgical technique and the development of adequate hormonal substitution to prevent adrenal insufficiency. The procedure was carried out in patients with metastatic cancer as follows: prostatic cancer, 7 cases; mammary cancer in women, 4 cases; miscellaneous neoplasms, 3 cases. In 5 cases of cancer of the prostate which became reactivated after previous antiandrogenic control, adrenalectomy gave relief of bone pain, increased appetite with weight gain, reduction of acid phosphatase levels in blood serum, shrinkage of the tumor, and resumption of normal activity. The longest postoperative period of observation was 9 months. Two cases of this type of cancer did not improve after adrenalectomy. Pulmonary metastasis in one man with mammary cancer regressed rapidly after adrenalectomy. Two women with mammary cancer were not improved. Pituitary adrenocorticotrophin and cortisone acetate administered to patients with extensive prostatic cancer (with intact adrenals) provided partial relief of bone pain, a sense of well-being, and increased appetite. The relief does not seem to be sustained at maintenance hormonal substitution levels.

Although the mechanism by which the absence of certain adrenal steroids modifies malignant growth processes is not as yet known, there can be little doubt that their removal profoundly alters the activity of certain types of malignant cells.

The Possible Role of Sexual Selection in the Etiology of Endemic Goiter

G. E. Hutchinson and Eva M. Low
Osborn Zoological Laboratory, Yale University*, and *Academy of Natural Sciences of Philadelphia

In the course of a survey of the biogeochemistry of iodine and bromine, the authors have been struck by the irregularity of correlation between the occurrence of endemic goiter and the available iodine of the environment. In company with many former investigators, they have felt other factors must be operating. Evidence exists of genetically determined thresholds in the action of antithyroid compounds on lower mammals, and there is some indication of a genetic basis for susceptibility to goiter. A study of literary and iconographic sources (presented in detail) indicates that at least from the sixteenth century the presence of a goiter was considered a highly attractive attribute of woman in some parts of Europe. Sexual selection acting on a population containing a small proportion of genes conferring susceptibility at a given iodine level might lead to a widespread diffusion of these genes in certain localized areas in which goiter would become particularly prevalent. The importance of the use of ideal types, easily found in provincial religious iconography, in the study of sexual selection is emphasized.

The Cytoplasm in Speciation

Donald F. Jones
The Connecticut Agricultural Experiment Station

The chromosomal mechanism brings about germinal mixture and recombination. All characters are the expression of an interaction between genes in the chromosomes and the cytoplasm or other extranuclear elements contained in it. Within the species nearly all visible variations are brought about by differences among the genes, which indicates that the cytoplasm and its component particles are alike. Many exceptions to this usual condition have been noted. These affect vital processes of chlorophyll formation and reproduction in plants. Many species crosses are partially sterile, and this sterility increases in backcrosses that bring an entire gene set into an unfamiliar cytoplasm. Reciprocal backcrossing that replaces the same gene set in its normal cytoplasm restores full fertility. Many plants are completely pollen-sterile in all progeny of certain matings in successive generations, but may be restored to full fertility when the proper genes are brought in by suitable matings. These genes are adapted to produce normal pollen when acting in some cytoplasms but not in others. This shows clearly that the harmonious interaction of genes and cytoplasm is necessary for normal growth and reproduction, and any deviation from this normal condition leads to a separation into groups that are unable to reproduce when intercrossed.

Biochemical Studies of Ascorbic and Glucuronic Acids

C. G. King, H. B. Burch, H. Horowitz, and J. Douglas
Columbia University

Biological synthesis of ascorbic and glucuronic acids from uniformly labeled (photosynthetic) D-glucose by the rat and guinea pig, respectively, does not change the distribution of C^{14} atoms in the carbon chain. When 1-C^{14}-D-glucose is used as a precursor, however, there is evidence of redistribution of C^{14} from its original position, ruling out the concept that C-1 in ascorbic acid is derived solely from either C-6 or C-1 in D-glucose.

Borneol-fed guinea pigs, supplied with 6-C^{14}-D-glucuronic acid by injection, show a rapid and major respiratory loss of C^{14}, similar to the pattern observed with glucose and ascorbic acid. In addition, some C^{14} appears in the conjugated end product, showing partial utilization of the preformed acid. However, the C^{14} is not confined to the C-6 position. Degradation studies are under way to define more completely the nature and extent of intermediate changes.

The Metabolism of Tocopherol in Laennec's Cirrhosis

Gerald Klatskin and David W. Molander
Yale University School of Medicine

In the experimental animal the structural integrity of the liver depends in part on an adequate supply of tocopherol; and diversion of the normal bile flow from the intestinal tract leads to overt signs of vitamin E deficiency. Such observations have stimulated interest in the metabolism of tocopherol in liver disease in man.

Low plasma tocopherol levels have been reported in cirrhosis and, on the basis of flat oral tolerance curves, have been interpreted as evidence of faulty intestinal absorption. In a previous investigation, however, it was found that there was no relationship between the concentration of tocopherol in the plasma and the height of the tolerance curve or the state of hepatic function, suggesting that other factors were operative.

The present investigation was undertaken to elucidate the significance of alterations in plasma tocopherol and tolerance tests in Laennec's cirrhosis. Balance studies, based on chemical analyses of the excreta, and studies of the plasma level and tolerance tests before and after saturation of the tissues with tocopherol were carried out.

It was found that cirrhotics in contrast to normals (*a*) excreted a smaller fraction of ingested tocopherol, and (*b*) had a sustained rise in plasma tocopherol concentration and exhibited a normal tolerance curve following tissue saturation.

It was concluded that in cirrhosis (*a*) there is no impairment of tocopherol absorption, (*b*) low plasma levels reflect low tissue stores and are probably the result of an inadequate dietary intake of tocopherol, and (*c*) flat tolerance curves are the result of rapid diversion of absorbed tocopherol to relatively unsaturated tissues.

The Abundances of the Elements

Gerard P. Kuiper
Yerkes Observatory, University of Chicago

During the past decade a considerable amount of reliable information has been accumulated concerning the relative abundances in the solar atmosphere, in O and B stars, and in planetary nebula. The solar data used here are those of Strömgren (1940), Menzel and Goldberg (1943), Wildt (1947), Unsöld (1948), and Minnaert (1950), supplemented by Bowen's determination of the solar O content (1948) and by corrected f values for iron (Kopferman and Wessel, 1951). Solar data do not cover all abundant elements, but they are beautifully supplemented by the early-type stars and planetary nebula. The O and B star studies are those of Unsöld (1941) and Aller (1946, 1949, 1950); the planetary nebulae by Menzel (1950).

The weighted mean astronomical values were combined with two groups of meteorite data, taken from Brown's compilation (1949). The first group, consisting of Na, Mg, Al, Si, K, Ca, Ti, Cr, and Mn, occurs evidently in approximately cosmic proportions in the silicate phase, and Fe, Co, and Ni occur similarly in the metal phase. Partly because of the poorly known numerical relation between these two groups, they were separately reduced to the astronomical abundance system (by use of an additive constant to logarithmic values). This results in abundances of Fe, Co, and Ni which are 3½ times smaller than according to the previous compilation. The logarithmic differences between the astronomical and meteorite abundances are ± 0.12 and ± 0.04 (mean errors) for the two groups of elements, which is quite satisfactory. All elements at least as abundant as 10^{-7} of hydrogen are included in the new compilation. Elements more abundant than 10^{-6} of H (by number) are: H, He, C, N, O, Ne, Mg, Si, S, Cl, A, and Fe, with log abund = 10.00, 9.14, 6.04, 6.38, 6.60, 6.67, 5.49, 5.46, 5.09, 5.0, 5.8, and 5.19.

The composition of the earth has been estimated from current geophysical data with the following results (fractional weights): Fe + Ni = 0.365, O = 0.307, Si = 0.154, Mg = 0.118, other elements 0.056. On this basis and from the cosmic abundance table, the minimum mass of proto-earth may be determined. It is found to be 620 times the present mass, quite consistent with the value derived dynamically ($1–2.10^3$). It also follows that the earth collected metallic iron more completely than the silicates, in a ratio of 2 or 2½ to 1. This result is not unexpected.

Cryogenic Research at Yale

C. T. Lane, *Yale University*

The periodic dependence of the diamagnetic susceptibility of metals on magnetic field is being studied for bismuth, zinc, tin, aluminum, and other substances. The work in progress at Yale at this time is mainly directed toward a test of the presence of an influence of the isotopic mass on the characteristics of the variation of the susceptibility with temperature. Separated isotopes are being used. Extensions to lower temperatures are in progress.

Electron mobilities in argon and helium show unexpected differences from electron-atom interaction constants which have been believed on the basis of measurements in gases.

The behavior of second sound in dilute solutions of He^3 in He^4 is being studied at ultra-low temperatures.

The change in the resistance of metals in magnetic fields in the He range of temperatures shows effects much larger than those at room temperatures. Results obtained for Hg are discussed.

The Problem of Crustal Deformation

Chester R. Longwell, *Yale University*

Students of tectonics continue the search for clues to solution of a major baffling problem—the mechanism of deformation in mountain belts. Systems of folds and thrusts, like those of the Appalachians and the Alps, record the operation of compressive stresses on a vast scale. According to the classic contraction hypothesis, these stresses are distributed throughout the crust and are transmitted through great distances to zones of failure. Apparent defects of this proposed mechanism, as tested by the sum of structural evidence, led to development of the convection hypothesis, which assumes drag of the crust above great convection cells, with resulting deformation through both compressional and tensional stresses. Serious objections to this concept also have been urged. There is growing interest in a third concept, according to which folding and thrusting result from gravitational sliding of vast crustal plates on the flanks of great welts, which in the older mountain belts have subsided. Some structural features in the Alps are now widely accepted as effects of gravitational sliding. Many competent Alpine students, however, regard these effects as secondary, and look for another cause of the major

deformation. Structural features of the Appalachians and of our cordilleran region are being re-examined in the light of the sliding concept.

Aboriginal American Metallurgy

S. K. Lothrop, *Peabody Museum, Harvard University*

A changed picture of New World metallurgy has recently arisen as the result of spectroscopic and quantitative analyses, as well as microphotography combined with dendrochronology and radiocarbon dating. As a result, much more is known about native ores, various alloys, and the characteristics that made them of use in industry.

Evidence now available places the earliest metalwork on the coast of Peru between 300 and 700 B.C. Annealing, soldering, and welding of gold and silver were employed. Casting of copper soon appeared in the southern mountains, where the discovery of tin led to the production of bronze. The early styles and techniques of the Peruvian coast disappeared, and, after several centuries, there was a renaissance or reinvention of metallurgy, the continuous growth of which can be followed until the Spanish Conquest.

In North America a copper industry based on "float" copper is of very early date, in some areas even preceding the use of pottery. Few technical changes have occurred, and no definite interrelationship with the south has been detected.

Isthmian and Colombian metalwork has as yet not been traced to its beginnings. The outstanding contribution of this area is *tumbaga*, a gold-copper-silver alloy as hard as bronze or soft steel.

No metals much before A.D. 1000 are known in Mexico, where most techniques seem to have been imported rather than invented, but skilled local craftsmen soon rivaled those of Peru.

Independent inventions and local processes were widely spread by Inca and Aztec commerce in the sixteenth century.

Simple Estimate of Atomic Diameters

H. Margenau and Maurice Karnaugh, *Yale University*

Atomic diameters are measures of the distance of approach between atoms at which strong repulsive forces set in. The correct way of calculating these forces leads to great mathematical difficulties, which arise chiefly from the mutual attractions between the electrons.

An attempt is here made to simplify these calculations by replacing electron-electron interactions, which involve the positions of two electrons, with suitable single attractions to the nuclei involving only the position of a single one. This process is not unique and is incapable of rigorous justification, but it can be made plausible on the grounds that it reproduces correctly the energy of each individual atom in the screening-constant approximation. It is similar to a procedure used successfully and made reasonable by Hylleraas in dealing with the term system of the H_2 molecule. The diameter of the helium atom computed in this way is surprisingly accurate. The method is being applied to other rare gas atoms.

Electron Microscope Studies of Viruses and Cells

Joseph L. Melnick, *Yale University School of Medicine*

The nature of the interaction of viruses and the cells they invade is being elucidated by the use of the electron microscope in different laboratories. Two approaches are discussed: (*a*) replication of the surfaces of erythrocytes treated with viruses, and (*b*) direct visualization of viruses within ultra-thin sections of infected cells.

Following treatment of intact human erythrocytes with influenza virus, three changes in the surface of the cells were observed: (1) presence of individual virus particles on the surface, (2) localized eroded or pitted areas which may contain single or clumped virus particles, and (3) a general roughening of the cellular surface.

The development of virus particles in the skin lesions of *Molluscum contagiosum* of man has been followed in ultra-thin sections of infected tissue. In a mature inclusion, the entire cytoplasm may be filled with virus particles. Inclusion bodies are often divided into locules by septa, with mature virus particles being present within the locules. Virus particles appear to arise from the material composing the matrix of the septa by a process of segmentation into a provirus phase, followed by condensation to form the mature virus. The virus particles themselves have been sectioned and have a formed cortex with a less dense interior.

Behavioral Effects of Food via Stomach Fistula Compared with those of Food via Mouth

Neal E. Miller, *Yale University*

Drives and rewards are important determinants of behavior. The present study starts to localize some of the mechanisms involved by comparing the hunger-reducing and the rewarding effects of food injected directly into the stomach with those of food taken normally by mouth.

The first experiment used the volume of milk consumed to measure hunger. Hungry male albino rats with small plastic-tube fistulas to their stomachs learned to drink enriched milk from a tube leading to a graduated cylinder. The effects of three procedures were compared: 14 ml of milk drunk by mouth; 14 ml of milk injected directly into the stomach; and 14 ml of normal saline injected directly into the stomach. The amounts of milk drunk immediately after these procedures were, respectively: 5.9, 8.7, and 18.0 ml. All differences are statistically reliable beyond 5%. Milk injected directly into the stomach had more effect than normal saline, but milk by mouth had the most effect.

The second experiment used the rate of learning to measure reward. When rats chose the correct arm of a T-maze, they got milk; on the incorrect arm they got normal saline. One group found the milk or saline in dishes, another had these substances injected directly into the stomach. As would be expected from the drive-reduction theory of reinforcement, both groups learned, and the first one learned faster than the second ($p = .01$). Milk injected directly into the stomach was a reward, but milk by mouth was a stronger reward.

The Molecular Structure of Societies

George P. Murdock, *Yale University*

It appears to be true of all science that the aspects which first attain rigorous precision are those concerned with the aggregation of standardized unitary elements into standardized larger systems. Astronomy, nuclear physics, chemistry, and genetics provide outstanding examples. Similarly, in the field of the social sciences, by

all odds the most precise knowledge achieved to date concerns the ways in which human individuals, as atoms, so to speak, are combined into very specific types of social molecules on the basis of kinship and locality. There are only two basic types of human atoms—male and female—but each has several ontogenetic phases, i.e., infancy, childhood, maturity, senescence. In the mature phase, the two atoms have a special affinity for each other, producing marriage and a localized family organization in every known society. They can unite in only three combinations—monogamy, polygyny, and polyandry—and can become localized in only four ways—by modes of residence called patrilocal, matrilocal, neolocal, and avunculocal. The children they produce can be affiliated with their relatives in only three ways, by rules of descent called patrilineal, matrilineal, and bilateral. The local group may be migratory or sedentary, and may or may not be linked to others by political bonds. The permutations and combinations of these variables produce a limited number of fundamental structural or molecular systems, according to which all the three or four thousand known human societies are organized.

Developmental Effects after Inversion of Neural Plate Materials

J. S. Nicholas
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The potentiality of embryonal floor plate material of the spotted salamander to form nervous tissues was tested by inverting a strip either with normal polarity or with other axes reversed. Such implants healed readily and did not complicate the immediately succeeding closure of the undisturbed neural folds, which behaved in apparently regular fashion in early-stage operations. When a slightly older stage was used, the neural folds did not quite approximate, and a double dorsal nervous system was formed when the implant was oriented with normal axiation. In some cases, triplicate nervous systems developed in the region of operation.

Microscopic examination shows that the inverted plate material forms nervous system and that its development is specific for the level of the neural plate chosen for operation. The cord or medulla is inverted and develops within the body cavity of the embryo and larva.

In those animals in which the axis of the implant was reversed, the nervous system developing within the body cavity was morphologically complete, and anomalous nervous structures developed from the normal neural folds. Abnormality was caused by diversion, reduction, reduplication, and inhibition of elements which ordinarily would have completed nervous system.

The experiments show that the material of the floor plate is fully competent to form nervous system characteristic of its embryonic level when the anteroposterior axis is not reversed. Disharmony produced by axial reversal is responsible for maldistribution of nervous elements.

The Interaction of α-Chymotrypsin with Enantiomorphic Molecules

Carl Niemann, *California Institute of Technology*

In the course of an investigation on the mode of action of the proteolytic enzyme α-chymotrypsin it has been observed that this enzyme can interact with the D- and L-forms of a number of enantiomorphic compounds which individually may serve as specific substrates or competitive inhibitors of the above enzyme. Although it has been suggested that the mode of combination of the enzyme with an L-specific substrate is substantially different from that of the enzyme with the enantiomorphic D-competitive inhibitor, it is suggested that there are no compelling reasons why this should be so. On the contrary, it can be shown that under certain circumstances both the D- and L-forms of an enantiomorphic pair can achieve a reasonable fit to a common complementary surface, and it is proposed that in principle the mode of combination of the enzyme with D- and L-enantiomorphs is qualitatively the same.

The High-Field Conductance of some Symmetrical Divalent Electrolytes

Andrew Patterson, *Yale University*

High-field conductance measurements have been made on magnesium and zinc sulfates by a new experimental measurement technique using a differential pulse transformer bridge circuit. The bridge circuit is described briefly. The high-field conductance results deviate from the theoretical values calculated from the Onsager-Wilson theory for symmetrical valence type strong electrolytes. This deviation may be accounted for by a combination of the Onsager-Wilson theory and the Onsager theory for weak electrolytes if a value of an ionization constant is assumed for the electrolytes under study. The nature of the deviation is examined.

Antibodies and Geography

John R. Paul, *Yale University School of Medicine*

In remote or tropical areas of the world where mortality and morbidity statistics either do not exist or are limited, one may learn something of the local prevalence of disease from serological surveys. These can be made by collecting sera from sample groups of the local population representing 200 or more people and covering a wide age distribution. At least a third of the serum samples obtained should be from children. By measuring antibody levels in these sera to a variety of antigens one can determine the numbers in each age group which contain antibodies, and such determinations can not only give some idea of the degree of recent or past exposure or infection but the age at which it has been acquired.

Studies are reported in which such antibody levels are measured for poliomyelitis, mumps, Coxsackie virus, hemolytic streptococci, and others. Samples of sera have been obtained from various parts of the United States and from arctic or semiarctic areas such as north coast of Alaska, and Iceland; from tropical and semitropical areas such as Cuba, Egypt, and South Sea islands. Interpretation of the findings is briefly discussed.

Physical Inactivation of Invertase

Ernest Pollard, W. F. Powell, and S. H. Reaume
Yale University

The effect of dry and wet thermal inactivation, of deuteron and electron bombardment, and of combined deuteron and thermal action on invertase has been studied. Thermal action in the dry state is in accord with the relation

$$k_1 = \frac{kT}{h} e^{\frac{\Delta S^{\ddagger}}{R}} e^{-\frac{\Delta H^{\ddagger}}{RT}}$$

where k_1 is the reaction constant for a monomolecular reaction, k is Boltzmann's constant, T is absolute temperature, h is Planck's constant, $\Delta S^{\ddagger}$ is the entropy of activation, R is the gas constant, and $\Delta H^{\ddagger}$ is the heat of activation. The value of $\Delta S^{\ddagger}$ is zero and of $\Delta H^{\ddagger}$ 30,000 cal/mole. In the wet state the enzyme is partially reversibly inactivated, in agreement with unpublished findings of L. G. Herriott. For the forward reaction $\Delta S^{\ddagger}$ is 95 cal/mole/degree centigrade, and $\Delta H^{\ddagger}$ is 53,000 cal/mole at pH 7. Both values depend on pH. The reverse reaction cannot be analyzed in this way, as the reaction constant rises and falls again with temperature.

Deuteron bombardment inactivates dry invertase with an efficiency which increases with increased ion density until a flat maximum is reached. The cross section at this maximum value corresponds to a spherical molecule of mol wt 120,000. Electron bombardment also readily causes inactivation, which permits the calculation of a target volume for a primary ionization. This agrees with a spherical molecule of the same molecular weight. The electron bombardment was carried out by M. Slater.

The effect of deuteron bombardment at various temperatures from 90° K to 400° K shows considerable variation. The cross section for inactivation is lower at 90° K, rises to a fairly constant value between 200° K and 320° K, and thereafter rises sharply. The constant value corresponds to the area of the whole molecule, and the increased cross section to a highly sensitive condition of the enzyme.

The Copper Metabolism of *Drosophila*

D. F. Poulson and V. T. Bowen

Yale University* and *Brookhaven National Laboratory

Uptake, distribution, and excretion of copper by larvae of 4 species of *Drosophila, D. ananassae, D. melanogaster, D. repleta,* and *D. virilis,* have been followed by determining activities of whole and dissected larvae at intervals after the feeding of Cu^{64} on various media at a series of copper concentrations. Uptake by larvae is proportional to concentrations between 0.25 μg Cu/g of food and 25.0 μg Cu/g. Within this range the data indicate that from 10 to 20% of the copper is located in the middle midgut cells. At higher concentrations, 25.0–50.0 μg Cu/g of food, disproportionately larger quantities of copper are present in these cells. The quantities of copper taken up from media in the presence or absence of yeasts are essentially the same. Copper previously incorporated in yeasts of the genera *Candida, Debaryomyces,* and *Hansenula* is also readily taken up by larvae. When yeasts grown on Cu^{64} are suspended in saline containing varying concentrations of stable copper, the uptake by larvae of Cu^{64} from these yeasts is not influenced by the stable copper concentrations. There are thus two definite paths of uptake, one for free copper, one for yeast copper. Excretion is slower than uptake and is performed chiefly by cells of the middle midgut. Autoradiographs show the greatest relative concentrations of Cu^{64} in the middle midgut cells, with the decreasing concentrations in other regions of the midgut and in the Malpighian tubules. The data are discussed in relation to histochemical and fluorescence studies.

The Effects of Domestication on the Steroids of Animals and Man

Curt P. Richter, *The Johns Hopkins Hospital*

The Norway rat is the first animal that has been domesticated for scientific purposes. It offers an excellent opportunity for the study of the effects of domestication since (1) more is known about its anatomy, physiology, and behavior than those of any other animal, and (2) its wild ancestor is still available in large numbers literally at our doorsteps.

Comparisons between the two forms have revealed great anatomical, physiological, and behavioral differences. Of most interest at the present time is that the adrenal glands have undergone a marked atrophy during the process of domestication. These glands are much smaller in size, less active and efficient, less able to help the animal protect itself from the effects of stress and fatigue. The operation of a selection process in a controlled environment may account for most of the changes that domestication has produced in this animal.

Man may have undergone parallel changes during his transition from a wild to a controlled, protected environment. As he has become more civilized, his adrenals may have become less efficient, thus accounting for the present-day high incidence of diseases that respond so remarkably to treatment with cortisone and ACTH.

The Extrusion of Desoxyribose Nucleic Acid from the Nucleus in the Formation of Nutritive Materials in the Egg

Franz Schrader, *Columbia University*

In many insects, the end chambers of the ovary contribute to the nutritive materials in the growing egg. In an analysis of this process—made with C. Leuchtenberger—it has been found that a breakdown of cell walls, as well as an irregular fusion of nuclei, is involved. A significant feature lies in the fact that, in a certain region of the ovarial end chamber, droplets of desoxyribose nucleic acid are extruded through the nuclear membrane. Such droplets join the stream of cytoplasmic materials that enters the egg. In the course of this transfer the desoxyribose nucleic acid undergoes certain changes and becomes Feulgen-negative. A preliminary analysis indicates that in such alterations a depolymerization, as well as a formation of polyaldehydes, takes place.

The Yale Linear Electron Accelerator

H. L. Schultz and W. G. Wadey

Yale University

The Yale linear accelerator has been designed to produce large currents of 15-mev electrons. It consists of a series of eight mutually uncoupled cavity resonators operating in the TM_{010} mode at 590 mc/sec. Synchronization problems have been solved by the use of 500-kw triode pulse power amplifiers to energize each cavity, the amplifiers being driven from a frequency-stable master source. Electrons are injected at 5 kev, and the strong bunching action in the first resonator is used to form the beam.

Special problems in design are emphasized, and the results of preliminary experiments with the accelerator are described.

Temperature-dependence of the Effect of Ionizing Radiation on Catalase

R. B. Setlow, *Yale University*

Bombardment of dried samples of catalase by deuterons causes a loss in the ability to catalyze the decomposition of hydrogen peroxide. The radiation sensitivity of the enzyme is expressed by its cross section, which is the reciprocal of the number of deuterons/cm^2 to give 37% relative activity. At room temperature the cross section corresponds to half a molecule of mol wt 250,000. Thus the passage of a deuteron through a catalase molecule does not destroy all its catalytic activity. Bombardments have been performed at temperatures ranging from 90° to 383° K with 4-mev deuterons. At this energy a deuteron produces an average of one primary ionization in passing through a catalase molecule. As the temperature is increased, the cross section remains constant up to 316° K, then increases within a 2-degree range, and remains constant until 377°, where it again increases within the same range. The cross section corresponding to the highest temperature agrees well with the size of the catalase molecule. At low temperatures the energy released by a primary ionization cannot spread throughout the entire molecule. Above the threshold temperature of 377° K the range can spread over the entire molecule.

Explorations in Three Galaxies

Harlow Shapley, *Harvard College Observatory*

In the continuing search for clues bearing on the origin and development of galaxies, we find it as profitable to explore the inner structure of the brightest and nearest systems as to investigate the population, structure, and dynamics of the metagalaxy. The present communication reports progress in the investigation of the inner structure of our own spiral and of the two middle-sized irregular galaxies—the Magellanic Clouds.

1. The central nucleus of our wheel-shaped system—the Hub—is under study in collaboration with Bart Bok, who has recently reported new results on the distribution of the clouds of absorbing material in the direction of the galactic center. He has spent much of the past two years at the South African Harvard station, where the new Baker-Schmidt telescope has gone into operation. Altogether some thousands of photographs have been made for the study of the variable stars, stellar spectra, colors, luminosities, and distribution in the nuclear region. We estimate that on photographs now available 10,000 new variable stars can be discovered, supplementing the thousands already found in the dense central star clouds. So many of the variables are of the type occurring in globular clusters that the early surmise (by Lundmark, Shapley, Baade, and others) that the nuclear populations of spiral galaxies resemble, or are exactly identical with, that of globular star clusters appears fully verified. The population at the centers of the Magellanic Clouds is quite different, and cluster-type variables are absent.

2. Using the photographic material accumulated during the past 10 years for the anti-center region of the Milky Way, we have now found several hundred new variable stars; those of lowest latitude were discovered chiefly by Hoffmeister and his colleagues at Sonneberg. The mapping of the galaxies brighter than magnitude 17.5, over an area of 4,400 square degrees, has yielded 22,500 galactic systems in the anti-center region. This survey will serve, in connection with the newly discovered Cepheid variables, to test the conclusion that our galaxy extends some 9 kiloparsecs (about 30,000 light years) in the anti-center direction, again demonstrating that it is a giant among the local galaxies.

3. Explorations in the Magellanic Clouds have produced evidence (*a*) on the tilt of the "bar" of the Large Cloud, (*b*) on the essential transparency of the Small Cloud (except possibly at the center), and (*c*) on the high opacity of the Large Cloud.

4. The analysis of several scores of variable stars in both Clouds by Mrs. Nail and assistants proves the existence of many superluminous stars ten thousand times the brightness of the sun, and the existence of gigantic Cepheids and irregular variable stars that are reddish like Betelgeuse and have a mean density like that of the highest vacuum attainable in the terrestrial laboratory. It is possible that what we call a supervoluminous star in the Magellanic Clouds is only a reddish gaseous shell that is maintained by radiation pressure and gravitation in a detached manner at a distance of half a billion miles from a central star of normal stellar proportions.

Transistor Electronics

W. Shockley, *Bell Telephone Laboratories*

The supremacy of the vacuum tube as an amplifier of electrical signals and a component of electronic computing machines has now been challenged by the transistor, a device usually made of germanium, a semiconductor, having no vacuum and no hot cathode. For some applications in which low power, small size, or extreme ruggedness are important, transistors are already superior to vacuum tubes. The functioning of transistors can be explained using the theory of semiconductors developed about 1931. This theory predicts that electrons in a semiconductor behave normally like negatively charged electrons and also cooperate so as to mimic the behavior of positively charged electrons, or "holes." Techniques developed during transistor research have permitted the investigation for the first time of many aspects of the behavior of normal electrons and holes and thus have contributed to the science of electrical conductivity. Conversely, transistor electronics, the engineering science based on this theory, has been applied in the design of devices and has led to the "junction transistor," a nearly ideal amplifier for very low power applications. Physical principles over a wide range are included in transistor electronics and are expected to produce a variety of devices comparable to that of conventional vacuum and gaseous electronics.

The Morphogenetic Significance of Reaction Wood

Edmund W. Sinnott, *Yale University*

The reaction wood (compression wood, redwood) of conifers differs in color and certain other characters from normal wood. It develops considerable lengthwise pressure, and, if present on one side of an axis, this tends to bend the axis away from this side. The distribution of reaction wood was studied in a series of terminal shoots and lateral branches of white pine which had been tied in various abnormal positions and held there during one or two seasons of growth. Reaction wood was found to be produced only where it would tend to restore the axis to its normal position. It therefore seems not to be a direct response to compression or other external factors

but to be regulatory in character. Since reaction wood is readily distinguishable, it provides a very useful means of studying experimentally the regulatory growth reactions involved in the development of tree form and thus offers favorable material for morphogenetic research.

An Algebra of Population Growth

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An algebraic notation capable of describing the population history of a genetically homogeneous asexual group of organisms is presented. Population oscillations and equilibria can be described in terms of the physiological state of the organisms. If it can be shown that a unique solution or a finite number of solutions exists to describe any population growth curve, then this notation predicts the physiological reactions of any organism in the population. The advantages of this notation over the existing population growth notations are (1) the occurrence of a lag period in population phenomena can be expressed, and (2) the differences in ecological effect between different individuals in the population can be expressed.

Some Cytological and Morphological Changes Induced in Plants by Ionizing Radiation

Arnold H. Sparrow
Brookhaven National Laboratory

Several species of plants have been exposed to chronic γ irradiation from Co^{60} for periods up to 4 months. There was considerable variation in the radiosensitivity of different species, but in one instance no significant effect was detectable after 2,000 r/day for 6 weeks. Generally, however, much lower dosages were sufficient to produce one or more characteristic morphological responses. These included, in addition to growth inhibition, some fasciation and various unusual shapes and sizes of leaves and of reproductive structures. Hypertrophic growth in certain structures was frequently produced in some species. In others tumorlike growths, as well as somatic mutations, were observed. In *Tradescantia paludosa* a dramatic increase in the number of both vegetative and flower buds was noted after chronic irradiation of about 30 r/day.

Cytological observations were made on both meiotic and somatic cells of irradiated *T. paludosa*. The expected types of chromosomal aberrations were found, and their frequency in both tissues was determined. Meiotic chromosomes were shown to be much more radiosensitive than chromosomes of somatic cells. This agrees with the observation that pollen sterility and morphological abnormalities in the anthers occur at dosages that have relatively little gross effect on somatic tissue.

Dosages which caused marked morphological changes also produced a considerable amount of chromosomal aberration. However, since recovery to a normal growth pattern occurred in many plants which had previously shown severe radiation damage, it would seem that most of the morphological aberrations were not of a genetic nature. It is considered that they were probably the result of radiation-induced physiological changes, although the possibility that they are somehow related to chromosomal aberrations cannot yet be excluded.

Problems of Gene Structure. I, The Interdependence of the Elements (S) and (P) in the Gene R^r of Maize

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U. S. Department of Agriculture and *University of Missouri*

Previous studies have shown that spontaneous mutation of R^r affects seed color action and plant color action independently, producing the alleles r^r and R^g, respectively. Mutant loss of seed color action has no detectable effect on the level of plant color action, and vice versa. Thus the action of R^r includes two apparently independent components. This suggests that the structure designated R^r may include two independent genes or genic elements, (S) and (P), which are very closely or completely linked. An alternative hypothesis is that R^r is a single unit (or complex functioning as a unit) with effects on two processes; a unit that may change in certain ways that modify its effect on one process and in other ways that modify its effect on the other.

Under the first hypothesis we may expect that mutation for plant color (P) will have no effect on the subsequent mutation rate for seed color (S), since (S) is the same gene before and after the mutation of (P). Under the second hypothesis, the mutation rate for seed color subsequent to mutation for plant color is unpredictable, as it depends on the stability of the gene R^g.

The mutation rates may be compared with precision in plants heterozygous for R^r and its mutant R^g. Comparisons of this type, made with several R^g mutants of separate origin, show that the frequency of mutation for seed color effect is reduced about tenfold in the R^g mutants. This indicates that (S) and (P) are not independent genes. There may be structurally distinct genic elements determining seed color and plant color action, but if so they are apparently parts of a functional complex.

Thermodynamics of Hydrolysis of Peptide Bonds

Julian M. Sturtevant, Alan Dobry, and Joseph S. Fruton, *Yale University*

The thermodynamics of peptide bonds is of fundamental importance in the study of the synthesis and breakdown of proteins in biological systems. We have undertaken a program of direct measurements of the heats and free energies of enzymatic hydrolysis of peptide bonds in compounds of known structure, since the data of this type at present available in the literature are of doubtful accuracy.

Results obtained for the hydrolysis of benzoyl-L-tyrosylglycinamide catalyzed by chymotrypsin are reported and discussed. The heat of hydrolysis was determined by a calorimetric method recently developed by one of the authors, and the free energy by a method employing N^{15} as tracer.

Chromatography and Exchange–Adsorption on Clay Minerals

Henry C. Thomas, *Yale University*

For a variety of reasons, of interest to the geochemist, the agricultural chemist, the physical chemist engaged with the theory of solutions, and those concerned with the possible effects on public health of the products of atomic fission, it is important that there become available a more comprehensive knowledge of the exchange adsorp-

tion of the cations on clay minerals. It is possible to apply the theory of the chromatographic process to the determination of these exchange isotherms. For a fairly general type of process it is shown that the approximate equation

$$f = \frac{1}{x}\left\{F + yc + \Delta\left(y\frac{\delta c}{\delta y} - c\right)\right\}$$

serves to determine an isotherm, $f(c)$, in terms of the behavior of the column of interest and of others run for isotopic exchange only. The details of the method, its advantages, and the possible sources of error are discussed.

The method has now been applied to a caesium-sodium exchange on a montmorillonite and to the same exchange on a synthetic exchanger. The results for these two cases are presented.

The Biological Effects of the Streptococcal Enzymes, Streptokinase and Streptodornase, on Local Areas of Disease in Patients

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Hemolytic streptococci as they grow elaborate into their surrounding medium a diverse number of independently acting extracellular substances. One of these reagents was initially described under the heading the fibrinolytic activity of hemolytic streptococci (now called streptokinase). This substance when added to a sample of human blood, *in vitro*, which is subsequently clotted, mediates the rapid and complete liquefaction of the fibrin clot in a few minutes.

Subsequently a second enzyme was found in the same streptococcal concentrates, which proved to be desoxyribonuclease (now called streptodornase); it rapidly depolymerizes desoxyribose nucleoprotein.

Since both fibrin and desoxyribose nucleoprotein are defined in technical chemical terms as fibrous insoluble proteins, and, since in diseases characterized by extravascular hemorrhagic deposits or purulent exudations, they often constitute unmanageable components of the areas of disease and are deterrents to recovery, local topical instillations of SK-SD have been employed for therapeutic effects in a variety of diseases. In many instances, striking and rapid favorable effects leading to cure have been observed.

The principles involved in the action of the enzymes on local diseased tissues have been a subject of considerable study. As biological reagents, their actions fall into three main categories: (1) eradication by liquefaction and aspiration of exudative substances that persist as mechanical deterrents to restoration of organic functions; (2) promotion of the eradication of obstinate chronic refractory infections (the enzymes are not, in themselves, bactericidal); and (3) promotion of regrowth and regeneration of tissues leading to effective healing.

Detailed clinical cases are given which illustrate the application of the above principles and the actual therapeutic effects.

Cosmic Abundances of the Elements

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Goldschmidt made a survey of the abundances of the elements in his classical work. He assumed that the meteorites were the best source of observational data for the preparation of such tables, and for the nonvolatile materials he weighted the stones, irons, and the troilite phase in the ratio 10: 2: 1. Brown revised these tables, added estimates for the lighter elements from stellar data, and weighted the stones and irons in the ratio of 3: 2, and neglected the troilite phase, adding sulfur from stellar abundances.

Early in my study of the origin of the solar system I concluded that the moon represented more nearly the average sample of material from which the planets were made than does the earth or the other terrestrial planets. There is a variation in the composition of the terrestrial planets, and, since a chemical process for fractionation is available which could remove silicate rather than iron, the lowest density material should be correct. The mean density of the moon at zero pressure and ordinary temperatures is estimated to be 3.5.

The chondrites from their structure indicate that they were produced in some sort of a silicate hailstorm, and it appears just possible that they in themselves represent a rather average sample. Prior's composition for the chondrites is 44% olivine, 30% augite, 10% feldspar, 9% iron phase, 6% troilite, and 1% minor constituents. If the iron is oxidized to magnetite, the density of this material should be approximately 3.5, thus agreeing with the estimate for the moon. Because of this agreement a table of abundances has been calculated. The siderophile elements are of course less abundant than those given by Goldschmidt and very considerably less abundant than those given by Brown. On the basis of silicon as 10,000 the atomic abundance of iron is 7,250 instead of 8,900 (Goldschmidt) and 18,300 (Brown). The ratio of iron to nickel is 30 instead of 13.6 (Brown) or 19.3 (Goldschmidt). Curves are shown illustrating the differences between the three sets of values.

The Optical Theory of Willard Gibbs

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In this paper is presented an outline of Gibbs' development of optical theory as presented in his published papers and in his manuscript notes. The principal difference between his development and the classical one of Maxwell lies in the definition of the quantity "displacement;" and to the unorthodox Gibbsian definition may be ascribed the neglect to which his views in the field of optics have been subjected.

The consequences of the two definitions are here worked out by computations based on the experimentally determined optical constants of metallic silver. Curves giving the density of the conduction electrons as a function of the frequency as determined from each of the definitions are shown, and compared with the normal incidence reflection curve of Hagen and Rubens. It is suggested that, since this comparison shows the Gibbsian hypothesis to be in closer accord with the experimental facts than the Maxwellian, a case has been made for a re-examination of Gibbs' theory and a further comparison of its consequences with those of the classical development.

Effect of Limited and Distributed Distensibility on the Pressure Pulses in the Arterial System

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The pressure wave created in the aorta by ventricular

ejection is altered in its transmission to peripheral branches partly by the superposition of a standing wave created, according to common belief, by reflection from peripheral branching arteries. The period of this wave depends on the volume of blood in the aortic system and the volume elasticity characteristics of the aortic compression chamber. Normally such superposition is responsible for augmentation of the primary wave in the femoral artery and the occurrence of a marked dicrotic wave.

Previous work has shown that when distensibility is increased over the entire length of aorta (distributed distensibility) the natural period of the system becomes longer and the transmission rate of pressure waves is reduced. As a result the dicrotic wave in the femoral artery is flattened or abolished.

Experiments recently carried out in our laboratory by Robert E. Whittlesey revealed that when the volume elasticity of the aorta was apparently doubled by insertion of a large compression chamber (limited distensibility) the aortic and femoral pressure pulses showed just the opposite of the anticipated effects. The following conclusions were reached:

1. The insertion of a compression chamber into the aorta does not produce a common system but two systems with independent natural frequencies.

2. Such a chamber affects pressures in the arterial system by abstraction of blood during the latter portion of systole and early diastole. This initiates a negative pressure wave and, through reverberation, a positive pressure wave in the arterial system proper. The natural frequency of the arterial system remains virtually unchanged. These negative and positive standing waves are superimposed on the aortic and femoral pulses and respectively account for the marked lowering of pressure at the beginning of diastole and an intensification of the dicrotic wave.

3. The reduction in pulse amplitude is not due to damping but to an effect of increasing the capacity of the whole arterial system.

Rice in Asia

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Throughout southern Asia, except northwest India and western Pakistan, rice is prevailingly the staple food of the masses, supplying about 80% of the daily calories. The life of the people centers largely in the production of rice, which requires an incredible amount of hand labor.

With progressive industrialization of the East, rice is increasingly milled to whiteness to render it more palatable and better adapted to storage during long transport from distant farm to city kitchen. Thus the tendency to beriberi is aggravated.

Large-scale experimental fortification of rice has been practiced in Bataan, Philippines, for the past 3 years. Whereas formerly there were 150–300 deaths from beriberi each year in this 93,000 population, no single death from this disease has been reported for the past 18 months.

The question of applicability of such a measure in other parts of Asia occasioned a recent tour of all principal rice-eating lands, where observations were made of the various factors involved. A major obscurity is the extent of beriberi in Asia, where few countries have trustworthy mortality figures. Accordingly, it is hoped that further trial introduction of the fortified product will give a better measure of the present extent of this need as compared with needs based on numerous other dietary shortcomings. Also food, politics, and peace are not unrelated, and interesting observations were made on these aspects of Asian life.

Technical Papers

Induction of Mutations with β-Propiolactone[1]

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In a search for new chemical mutagens, compounds are being screened on the basis of tests using *Vicia faba* and *Neurospora crassa*. Results are reported here with the compound β-propiolactone, which was found to be effective in (1) inducing chromosomal aberrations in mitotic divisions of root tip cells in *V. faba*; and (2) causing reversions to growth-factor-independence in biochemical mutant strains of *N. crassa* and inducing gene mutations which confer resistance to the antibiotic effects of canavanine on *Neurospora*.

[1] This investigation was supported by a research grant from the National Cancer Institute, of the National Institutes of Health, USPHS. Published as Paper No. 271, Department of Plant Breeding, Cornell University.

β-propiolactone[2] is the simplest lactone, and consists of a 4-membered ring containing 1 oxygen and 3 carbon atoms. The structural formula is $CH_2-CH_2-C=O$ (with O).

Compounds with 4-membered rings are usually characterized by great chemical activity because of the tendency of the ring to open. The highly strained ring of β-propiolactone is known to open under the influence of many types of reagents to form a large variety of compounds. β-propiolactone is a liquid (bp, 155° C at 760 mm) and is soluble in water (37% by vol, at 25° C). The compound is available in quantity owing to its use in the field of industrial synthetic organic chemistry.

Preliminary trials with *V. faba* root tips, at different concentration-time levels, showed that immersion in a 0.05% aqueous solution of β-propiolactone for 20

[2] Appreciation is expressed to the B. F. Goodrich Chemical Company, Cleveland, Ohio, for supplying β-propiolactone in lots for experimental purposes.

TABLE 1

FREQUENCY OF CHROMOSOMAL ABERRATIONS IN *Vicia faba* ROOT TIPS TREATED WITH β-PROPIOLACTONE

Treatment: concentration, time	Recovery time (hr)	No. anaphases examined	No. chromosome aberrations	Anaphases with aberrations (%)
(1) *Preliminary trial*				
0.05%, 20 min	24	81	3	3.70
	48	100	16	16.00
Control	24	100	0	0
	48	100	0	0
(2) *Confirmatory trial*				
0.05%, 20 min	48	813	117	14.39
Control	48	700	1	0.14

min was a threshold sublethal dosage at which chromosomal aberrations were produced. Root tips were fixed immediately after treatment and at subsequent intervals of 6, 24, and 48 hr, during which they were grown in moist vermiculite. No aberrations were found in cells fixed immediately or 6 hr after treatment. In cells that were fixed 24 or 48 hr after treatment, aberrations were observed to occur in the frequencies shown in Table 1.

The most frequent aberrations observed were 1 or 2 large fragments that lagged at anaphase (Fig. 1).

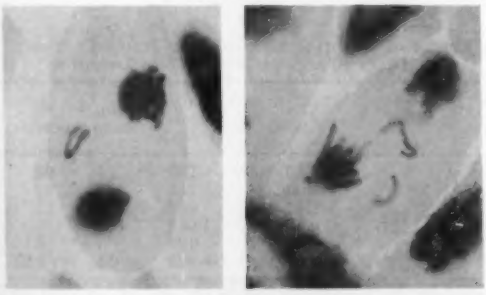

FIG. 1. Two anaphase figures showing chromosomal aberrations in root tip cells of *V. faba* (×900) that had been treated 48 hr previously with β-propiolactone.

The size of the fragments indicated that the breaks occurred most frequently near the centromere, possibly in heterochromatic regions, and in some figures there appeared to be inactivation rather than loss of the centromere region.

Two other, more complex lactones have been reported to cause chromosomal abnormalities. Ostergren (*1*) found that coumarin (O-hydroxycinnamic acid lactone) produced chromosome bridges and breaks in *Allium cepa*. Erickson and Rosen (*2*) reported that protoanemonium, $C_5H_4O_2$, produced cytological disturbances in root tip cells of *Zea mays*, though crucial evidence on recovered cells was lacking.

Induction of gene mutations in *Neurospora* is being investigated by methods essentially the same as those utilized by Kölmark and Westergaard (*3*) and by Dickey, Cleland, and Lotz (*4*). Reversions to growth-factor-independence are being studied both in adenineless and inositolless colonial strains. Treated spores are plated onto minimal agar medium, and the appearance of growing colonies is taken as initial evidence of mutation. The colonial gene has also been incorporated into a canavanine-sensitive strain (*5*). In experiments with the colonial canavanine-sensitive strain, treated spores are plated onto media containing canavanine in order to detect mutations for resistance. In all our experiments controls are established by plating untreated spores from the same cultures which have served as the source of the treated material. Except for exposure to the mutagen, control spores are carried through all of the processes involved in treatment, and for the same time periods.

TABLE 2

MUTAGENIC EFFECT OF TREATMENT WITH 0.01% β-PROPIOLACTONE FOR 12 HR ON 2 STRAINS OF *Neurospora*

Treatment	Strain 70,007–37,401 (inositolless)			Strain 70,007–38,701 (adenineless)		
	No. conidia plated	No. colonies formed after plating	No. mutations per 10^8 conidia	No. conidia plated	No. colonies formed after plating	No. mutations per 10^8 conidia
Controls (untreated)	52.7×10^6	0	0	7.2×10^6	0	0
UV*, 1 min	28.4×10^6	158	5.56	3.3×10^6	5	1.51
UV, 2 min	28.4×10^6	243	8.56	3.3×10^6	8	2.42
β-Propiolactone	48.8×10^6	7	0.14	5.5×10^6	84	15.27

* The source of ultraviolet light was a G-E germicidal lamp, approximate calibration 75 ± 10 ergs/mm²/sec.

Table 2 shows the results of an experiment in which inositolless and adenineless spores were treated with 0.01% β-propiolactone for 12 hr. As part of the same experiment, spores of the mutant strains were exposed to ultraviolet light. The results of this latter treatment, together with the values obtained with untreated spores, serve as indications of the effectiveness of treatment with the lactone.

Recognizing that relatively long treatment periods complicate the analysis of mutation experiments, we have attempted to obtain evidence for the mutagenicity of β-propiolactone over shorter periods of treatment. Table 3 records the results of a recent experiment in which samples of spores of the adenineless strain were treated for 1 hr at three concentration levels and at two temperatures. The results show that effective mutagenic action can be obtained with β-propiolactone, even when the treatment periods are relatively short.

TABLE 3

EFFECT OF 1-HR TREATMENT WITH β-PROPIOLACTONE ON *Neurospora* STRAIN 70,007–38,701 (adenineless)

	25° C			35° C		
	No. conidia tested	No. colonies formed after plating	No. mutations per 10^8 conidia plated	No. conidia tested	No. colonies formed after plating	No. mutations per 10^8 conidia plated
Control	1.75×10^8	0	0	2.00×10^8	0	0
0.01%	2.63×10^8	6	2.28	2.50×10^8	10	4.00
0.02%	2.75×10^8	10	3.64	2.75×10^8	15	5.45
0.03%	3.13×10^8	12	3.83	2.38×10^8	17	7.14

Mutagenicity of β-propiolactone against different loci in *Neurospora* seems now to be well established. Besides the evidence from reversions of the adenineless and inositolless strains, we find that treatment with the lactone substantially increases the number of canavanine-resistant colonies which appear when canavanine-sensitive spores are plated onto canavanine-containing medium. However, the spontaneous appearance of canavanine-resistant colonies is relatively high. And, in addition, some instances of appearance of growth spots on canavanine medium appear not to be due to gene mutation. We have, therefore, placed more reliance on tests with the adenineless and inositolless strains. It seems clear that mutation accounts for most of the reversions to growth-factor-independence in these strains. Colonies that appear after plating have all been picked, established in separate culture, and then tested on minimal medium. All such cultures have shown the ability to grow on minimal medium. We have also made crosses of these cultures back to strains carrying the original mutant gene, but of opposite mating type. Ascospore isolates have been made from approximately one fifth of these crosses, and from all of the crosses wild-type progeny have been recovered.

Two phenomena of interest have been observed in these mutation experiments. One is the apparent effect of temperature on the mutagenic action of β-propiolactone, as indicated in Table 3. The other is the fact that in experiments so far, β-propiolactone has appeared to be considerably more effective in creating mutations in the adenineless strain than in the inositolless strain, although our ultraviolet treatments show the opposite effect. Both of these phenomena are under further investigation.

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Influence of Diethylstilbestrol on *Drosophila melanogaster* Tumors

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The capacity of estrogenic substances to induce, stimulate, or inhibit tumor development in several species of vertebrates suggested an investigation as to whether these substances exhibit similar properties in relation to invertebrate tumors.

Three different hereditary, benign-tumor-bearing *Drosophila melanogaster* stocks were raised in food cultures containing diethylstilbestrol. The stocks used were st sr; tu-36a, described and analyzed by Russell (*1*), which presents 4–5% tumors at laboratory temperature (20°–25° C); bw(tu), with a tumoral frequency which fluctuates around 50%, according to Hartung (*2*); se e^{11}; tu-49th, which was formed in our laboratory and which has a tumoral incidence of 40–50% (*3*).

Sterile eggs of the three stocks were cultivated in shell vials containing a sterile medium composed of water, agar, ammonium sulfate, magnesium sulfate, tartaric acid, monopotassic phosphate, and dead brewer's yeast, after the formula suggested by Birch (*4*); 1% diethylstilbestrol was suspended in the medium. Control flies were cultivated in an identical medium without the drug.

TABLE 1

EFFECT OF DIETHYLSTILBESTROL ON TUMOR INCIDENCE IN THREE STOCKS OF *Drosophila melanogaster*

Stock	Treatment	No. individuals	No. tumors	% tumors
bw(tu)	DSB 1/100	255	73	28
	Controls	287	138	48
se e^{11}; tu-49h	DSB 1/100	482	76	15.7
	Controls	1,058	489	46.2
st sr; tu-36a	DSB 1/100	120	5	4.1
	Controls	223	14	6.2

The *D. melanogaster* eggs collected according to the method suggested by Schweitzer (*5*), were sterilized for 20 min in a 1/10,000 solution of sodium mercury thiosalicilate (Merthiolate "Lilly") in 70° alcohol. After being rinsed in 70° alcohol or saline solution, approximately 50 eggs were put into shell vials containing the medium. The treated and the control eggs were cultivated under the same environmental conditions.

As a result of the experiments (Table 1), it was observed that the flies raised in the medium containing diethylstilbestrol presented a lower percentage of tumors than those cultivated in the control vials. This lower number, nevertheless, was statistically significant only in the stocks of high tumoral incidence: bw (tu) and se e^{11}; tu-49h.

The experiments indicate that diethylstilbestrol,

under the conditions mentioned, interferes with the tumor development of *D. melanogaster* (at least in two of the three stocks), showing properties which could, up to a certain extent, be compared with some mammal tumors.

In the present stage of our investigations, it is impossible to give an explanation of the results. The action of the drug could be direct on the tumoral tissue; or the effect could be indirect, through some endocrine gland of the insect or through the modification of a chain of reactions controlled by these hormones; or, last, the action could be through a general toxic effect which influences the neoplasmic growth.

We are now working on experiments designed to answer some of these questions.

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Pteroylglutamic Acid Activity of Aminopterin in *Tetrahymena geleii*[1]

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During the course of some experiments on the interrelationships of steroids with pteroylglutamic acid (PGA) in the ciliated protozoan *Tetrahymena geleii*, an attempt was made to reverse the action of the PGA analog aminopterin (4-amino-PGA). Contrary to what was expected on the basis of observations in other organisms, it was found that aminopterin possesses high PGA activity for *Tetrahymena*.

Since aminopterin replacement of PGA has never, to the authors' knowledge, been previously reported,[2] it was felt that these data are significant, in that they may help to explain the structural conditions in the PGA molecule necessary for PGA action *in vivo*. This is the basis for this preliminary report.

TABLE 1

Response of *T. geleii* to Aminopterin*

Aminopterin added (mg%)	No PGA added	6.0 μg% PGA added
0	.036	.906
0.001	.052	.936
0.01	.780	.960
0.10	.888	.950
1.00	.960	.964
5.00	.886	.980

* Results shown represent optical densities of third serial transplant cultures.

[1] Supported by a grant from the American Cancer Society on recommendation of the NRC Committee on Growth.

[2] G. W. Kidder, of Amherst College, has kindly informed us of similar studies made in his laboratory, the results of which are now in press.

TABLE 2

Composition of Basal Medium*

Solution B (amino acids)	14.0	ml%
Solution C (vitamins)†	6.0	"
Solution D (salts)	2.5	"
Solution E (salts)	0.6	"
Solution F (phosphates)	0.175	"
Solution J (purines and pyrimidines)	5.0	"
Glucose‡	0.5%	
Sodium acetate	0.2%	
Protogen§	2.0	
Tween 80	2.4%	
pH 7.0		

* The compositions of the solutions listed here are identical with those listed by Dewey *et al.* (*1*, 284).
† Solution does not contain PGA.
‡ Autoclaved separately and added aseptically.
§ Units/ml.

Results of a typical experiment are shown in Table 1. To obviate the possibility of PGA contamination of the aminopterin sample, the experiments were repeated with different aminopterin preparations. Results were essentially similar in all cases.

The ciliated protozoan *T. geleii* H was grown in pure culture. The base medium was essentially that of Dewey *et al.* (*1*), modified as indicated in Table 2. The organisms were grown in 50-ml Erlenmeyer flasks containing 5 ml of medium, according to the technique described by Hutner (*2*). All inoculations were made through a dilution flask containing only basal medium. Following inoculation, the flasks were kept at 25° C, and the cultures were harvested at the end of the logarithmic growth phase. Optical density of the harvested cultures was determined by the use of a Klett-Summerson photoelectric colorimeter with a green (#54) filter, following the procedure of Elliott (*3*).

From the data in Table 1, it is apparent that the addition of about 0.1 mg% of aminopterin equals the full effect upon growth of 6.0 μg% of PGA.

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3-(*p*-Chlorophenyl)-1,1-Dimethylurea—A New Herbicide

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In the course of a study dealing with materials having plant-regulating properties, 3-(*p*-chlorophenyl)-1,1-dimethylurea, a new chemical compound, has been synthesized and found to be very effective in killing many plant species. In greenhouse tests described in detail below, it has appeared particularly effective in killing both annual and perennial grasses.

[1] Acknowledgment is made to L. E. Cowart, H. E. Cupery, R. S. Johnson, G. L. McCall, W. C. Miller, B. C. Pratt, N. E. Searle, T. C. Ryker, M. B. Weed, and D. E. Wolf for their assistance in these studies.

TABLE 1

Plant	Spray conc (%)
Tomato	0.05
Johnson grass seedlings	0.5
Established Johnson grass	3.0
Bermuda grass	1.0
Quack grass	1.0
Nut grass	3.0

The initial effect generally is leaftip dieback, beginning on the older leaves. This is followed by progressive chlorosis and retardation of growth, ending in the death of the plant. Preliminary observations in field experiments suggest strongly that 3-(*p*-chlorophenyl)-1,1-dimethylurea acts readily through the root system and is translocated upward to the leaves.

3-(*p*-Chlorophenyl)-1,1-dimethylurea was synthesized by reaction of *p*-chlorophenyl isocyanate with dimethylamine. The product melts at 169.8°–170.4° C. After crystallization from methanol, it is obtained as thin rectangular prisms which melt at 170.5°–171.5° C. It is an essentially neutral, stable substance, insoluble in water, and only slightly or moderately soluble in most organic solvents. Its solubility in acetone is sufficient for greenhouse tests such as those described here.

Preliminary toxicity tests conducted by the Haskell Laboratory of Industrial Toxicology of this company indicate that the LD_{50} of 3-(*p*-chlorophenyl)-1,1-dimethylurea by oral administration to male rats is approximately 3,500 mg/kg of body weight.

Various concentrations of 3-(*p*-chlorophenyl)-1,1-dimethylurea have been sprayed on test plants in the greenhouse, as shown in Table 1.

In these experiments, all plants used for the work were grown in 4-in. clay pots. Tomato plants, grown from seed, and Johnson grass seedlings were sprayed when 6–7 weeks old. Bermuda grass, quack grass, and Johnson grass were established from root stocks. Nut grass was established from tubers. All these established grasses were sprayed approximately 3 months after planting.

In the case of tomato plants, first symptoms appeared 3 days after spraying. The plants were dead in 7–14 days. With Johnson grass seedlings, first reaction was noted in 5 days, and the plants were dead 14–28 days after spraying. In the case of established perennial grasses, the initial response was noted in 7–10 days. Both tops and roots were killed in 2–3 months.

TABLE 2

	Age of plant at time of treatment (days)	Percentage kill at conc of	
		0.1%	0.25%
Meadow fescue	20	0	100
Wheat	12	100	100
Timothy	20	99	100
Sudan grass	20	75	99
Rye grass	29	100	100
Harting grass	29	65	100
Orchard grass	25	100	100
Prairie brome	25	65	100
Meadow foxtail	29	100	100

In another series of greenhouse experiments, a wider range of grass seedlings was sprayed with two concentrations of 3-(*p*-chlorophenyl)-1,1-dimethylurea, as shown in Table 2. The percentage kill at these concentrations is also given.

The seedlings used in this experiment were grown in flats in the greenhouse, and ranged from 2 to 6 in. in height at the time they were sprayed. In the case of most of these seedling grasses, the first symptoms appeared in 2–3 days. The percentage kill shown in Table 2 was reached 2–3 weeks after treatment.

More detailed field investigations are still in progress to determine the effectiveness of 3-(*p*-chlorophenyl)-1,1-dimethylurea against a wide variety of annual and perennial weeds. Tests are also being conducted to determine the persistence of the compound when applied in various types of soils.

Tritium in Radioautography[1]

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One of the advantages of the radioautographic technique to the biologist is its ability to localize a radioactive element or compound to a particular organ, histologic unit, or to a distinct cell group in an organism. Many labeled compounds and elements have been traced to specific zones of concentration in animal and human organs. The ultimate goal of radioautography is to identify the site of emission of the radioactive element or compound in terms of intracellular structure such as nucleus, nucleolus, cytoplasm, or mitochondria. Or, if the concentration were intercellular, the identification of areas of radioactivity as those of collagen, interstitial fluid, reticulum, or similar structures would be of considerable importance. A resolution of a few microns or less would be required for such demonstration.

Most past studies have failed to show such fine delineation. Emulsions of the required resolving power were not available. Recently, however, with the use of nuclear track plates, radioactive lines of 2.5 μ width can be distinguished, and this brings the emulsions to the intracellular level (*1*). The other factor has been the range of the emitted radiation. Even weak β-emitters such as C^{14} and S^{35} have 90- and 100-μ maximum paths, respectively, in the nuclear track emulsions. If all activity were recorded in the autograph it is obvious that the isotope would give too diffuse an image to localize the site of activity in one cell. The disadvantages of a long average path are lessened by a shorter

[1] This work was supported in part by grants-in-aid from the Atomic Energy Commission No. AT(30-1)-910.

exposure time and longer emulsion development, so that individual β-tracks are recognizable. By this method, C^{14} in liver and blood cells (*2, 3*), P^{32} in *Colpidium* (*4*), S^{35} in cartilage, and Fe^{59} in rat placenta have been identified (*5*). A disadvantage is that β-particles having a high energy give rather wide grain spacing at the start of their track, and intracellular localization seems unobtainable with many isotopes. Campbell estimated that tracks from S^{32} and Fe^{59} could be correlated with morphologic structures of the order of 10 μ (*5*). Very thin emulsion layers increase considerably the resolving power for some isotopes. α-Particle emitters give a distinct, recognizable path in emulsions that allows one to trace the particle to its origin (*6*), but these elements are foreign to biological material, and many problems arise in their use as a label.

FIG. 1. Radioautograph (#51-24-K). One-micron section of many paramecia. Diffuse activity with endoplasmic and ectoplasmic concentrations. Some areas of activity between organisms (radioactive organisms or debris). Exposure 2 weeks, E. K. NTB, 10 μ, emulsion; unstained; original magnification, × 460.

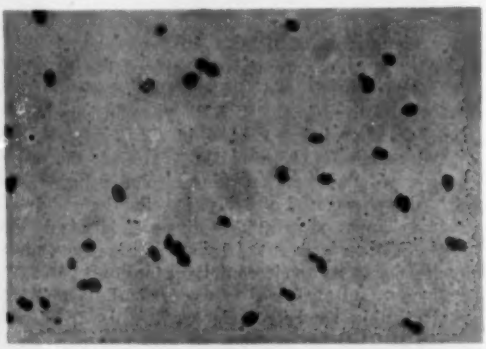

FIG. 2. Radioautograph (#51-35) of yeast cells obtained by placing Kodak Limited NTB stripping film over smear of dried organisms. Three weeks' exposure; unstained; original magnification, ×492.

Of great advantage would be a radioactive isotope of an element commonly occurring in biological material which has a very short path in emulsion. Tritium,

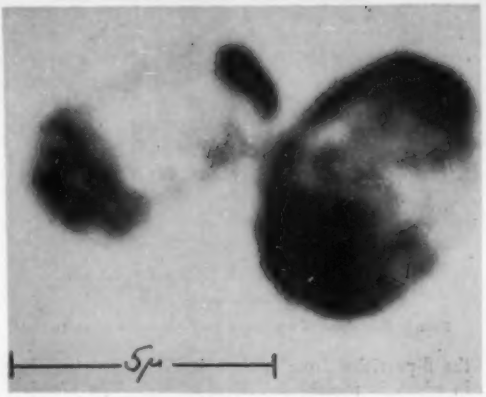

FIG. 3. Radioautograph (#51-19) of yeast cells. NTB$_2$, 25 μ, emulsion covered with a thin Formvar film and an aqueous suspension of organisms smeared on the film. Organisms were washed off during removal of Formvar. Extranuclear polar and peripheral concentrations of the isotope. Formvar coat caused slight diffuseness of image; 8 days' exposure, 2 min development, D19; original magnification, ×1800.

the hydrogen isotope of mass 3, emits β-particles having a maximum energy of only 17.9 kev (*7*) and a maximum range of about 6 μ in a medium of unit density. Since the average density of nuclear plates is between 3 and 4,[2] the longest tracks would be about

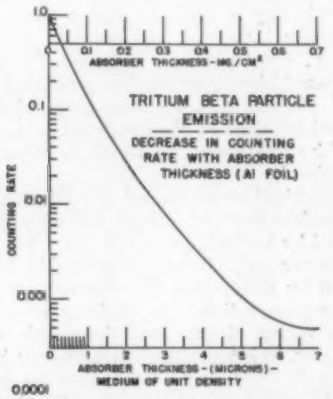
1.0
0.1
0.01
0.001
0.0001
COUNTING RATE
0.1 0.2 0.3 0.4 0.5 0.6 0.7
ABSORBER THICKNESS - MG./CM²
TRITIUM BETA PARTICLE EMISSION
DECREASE IN COUNTING RATE WITH ABSORBER THICKNESS (Al FOIL)
0 1 2 3 4 5 6 7
ABSORBER THICKNESS - (MICRONS) - MEDIUM OF UNIT DENSITY

FIG. 4. Counting rate of a tritium standard as a function of absorber thickness.

2 μ, although most tracks would be shorter. This small path would be compatible with intracellular resolution. It is shown in this report that tritium can be used for radioautography and that it gives resolution of a few microns in individual yeast and paramecium cells (Figs. 1–3). Actually, by short development of emulsion, localization of activity to individual grains can be achieved.

Effect of absorbers on tritium. The short range of

[2] A nuclear track emulsion consisting of equal volume percentages of silver halide and gelatin with densities of 6.5 and 1, respectively, has an average density of 3.75. The grain diam are 0.2–0.4 μ (*8*). There is, therefore, the strong possibility that only one grain will be reduced by most β-particles.

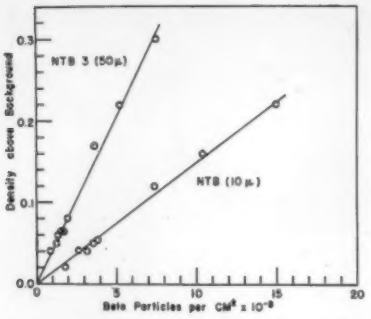

FIG. 5. Response of emulsion to β-particles from tritium.

the β-particles from tritium is illustrated in Fig. 4, in which is plotted the effect of very thin aluminum foil absorbers on the counting rate of a solid sample containing tritium.[3] The counting rate relative to the absorber-free sample is plotted as ordinate. As abscissas are indicated absorber thicknesses in units of mg/cm² and microns in a medium of unit density. The flux of β-particles is reduced to 0.1, 0.01, and 0.001 of the surface value by absorber thicknesses (of unit density) of 1.2, 2.8, and 5.1 μ. For emulsion densities averaging 3.5, these thicknesses correspond to 0.34, 0.80, and 1.5 μ, respectively.

Tritium-containing standards. Tritium-containing samples having an area of 1 cm², a thickness of approximately 1 mg/cm², and counting rates ranging from 4×10^3 to 4×10^4 cpm were used. The active compound was 11-keto-pregnanolone containing randomly labeled tritium.[4] Samples were prepared by adding methanol solutions of the compound to a flat aluminum disk and allowing the solvent to evaporate while being stirred.

The standards were counted as solid samples, using a windowless flow gas counter, following the method described by Eidinoff and Knoll (*10*). The β-particle emission per cm², plotted as abscissa in Fig. 5, was obtained by multiplying the observed counting rate by the exposure time. The efficiency of counting in the gas volume directly over the sample was taken to be unity. This assumption is supported by the observation that measured counting rates are equal when using the upper end of the proportional region for a gas mixture at close to 4,000-v operating voltage or the Geiger-Müller region for a gas mixture at 1,400 v. Displacement of the sample by 1.5 mm toward the anode wire along the axis of the cylindrical tube did not change significantly the observed counting rate. The total area of the sample pans was 10 cm², and only the central 1-cm² area was used for counting.

The tritium-containing standards were sandwiched between a glass slide with emulsion and a plain glass slide. The flat surface of the compound was in contact with the emulsion and the specimen was held in place by steel clips. Nuclear track types of emulsion (Eastman Kodak, NTB, NTB_2, NTB_3, NTA), No-Screen X-ray Emulsion, and Medium Contrast Lantern slide emulsions were used.

Standards were exposed for periods varying from 1 to 4 weeks. All exposures were in black, light-tight, plastic boxes kept in a refrigerator at about 5° C. Development was in D19 solution for 4 min at 20° C, except for a few slides developed for 2 min to show differential concentration, and some for 20 min for possible tracks. An acid stop bath of 1% acetic acid was used, and fixation was accomplished with 28% sodium thiosulfate.

The density of the radioautographic image produced by the standards was measured by a Sweet-Ansco densitometer, which was calibrated by an optical film wedge. The aperture was 2 mm. All densities recorded were the maximum for the standard and represent density above adjacent background.

Similarly prepared samples of 11-keto-pregnanolone, not containing tritium, were used as controls in order to detect pseudophotographic effects. Tritium-containing standards were also placed on an emulsion covered by a layer of Formvar prepared by dipping the emulsion on a glass slide into a 1% ethylene dichloride solution of the polymer and allowing the solvent to evaporate.

Preparation of biological specimens. Paramecium aurelia,[5] variant 51.7, was grown in a timothy hay infusion medium in which *Aerobacter aerogenes* had been incubated at 27° C for a 48-hr prior period. Six ml of test animals was placed in 18 ml of the standard medium, to which 0.5 ml of an aqueous solution of sodium acetate containing tritium was added. The activity of the water was 2×10^7 disintegrations/min/mg, and the sodium acetate, labeled in the methyl groups with tritium, had an activity of 4×10^7 disintegrations/min/mg of the anhydrous salt. The paramecia were kept for 7 days in this medium at a temperature of 27° C.

After growth, paramecia were fixed for 10 min in 2% aqueous osmic acid solution, washed with distilled water, and fixed in 2% U.S.P. formalin solution for 2½ hr. After being washed in distilled water and dehydrated in 70, 95, and 100% alcohol, the organisms were placed in an ether-alcohol solution, embedded over a period of 2 days in celloidin, and finally in two changes of paraffin to give a rigidly embedded block. Sections were cut at 1 μ on a wedge-type microtome using a reservoir containing acetone (*11*). The sections were transferred to a water bath, floated onto photographic emulsions, deparaffinized, dried, and stored at 5° C for appropriate exposure periods.

Whole organisms were put through the same initial procedures but after being fixed, were washed, centrifuged, and kept in distilled water. A control group of organisms was processed simultaneously under sim-

[3] The measurements were made using a windowless flow counter; details will be published elsewhere (*9*).

[4] This compound was prepared in a collaborative study with T. F. Gallagher and D. Fukashima, of the Division of Steroid Biochemistry.

[5] The paramecia were prepared and kindly made available by Leonard Hamilton, of the Division of Experimental Chemotherapy.

ilar circumstances, with the exception that the medium contained no radioactivity.

Torula utilis, a saprophytic yeast, was grown in a salt solution (*12*) in which the only source of nitrogen was ammonium ion and the only source of carbon was 2% sodium acetate containing tritium.[6] The test organisms were grown in 2 ml of medium in a shaken culture for 4 days at 25° C. The activities of the water and sodium acetate in this medium were 2×10^6 and 4×10^7 disintegrations/min/mg, respectively. The yeast were washed with distilled water, centrifuged 6 times, and kept in distilled water. Control organisms were simultaneously processed, with the exception that the medium contained no radioactivity.

Radioautographic technique. Only the nuclear track emulsions were used with the biological specimens. Eastman Kodak NTA, NTB, NTB_2, and NTB_3 emulsions and Kodak Limited Autoradiographic Stripping Plate (*13*) were used. (The use of the Autoradiographic Stripping Plate greatly increases resolution for most isotopes because only a few grains are present to record a portion of an otherwise long track and the diffusion of the image is less [*13*]. With tritium, since only one grain is ordinarily made developable, thickness of emulsion is not significant and the Stripping Plate is used because of its low background.) A drop of distilled water containing the radioactive organisms was placed on these emulsions. Drops of the organisms in suspension were placed on other glass slides. After drying, the slides were apposed to emulsion surfaces. Sections of the paraffin-celloidin-embedded paramecia were transferred to a water bath, floated onto photographic emulsions, deparaffinized, dried, and exposed. Other deparaffinized paramecium sections on a glass slide were covered with the Kodak Limited stripping film.

To rule out pseudophotographic effects, two types of control experiments were performed. Yeast and paramecia grown in a nonradioactive medium, but otherwise identical with the respective radioactive organisms, were processed simultaneously, placed on similar emulsion, and exposed for equal time periods. In a second group, one half of the emulsion on a glass slide was coated with Formvar by dipping the slide in a 1% ethylene dichloride solution of the polymer and allowing the solvent to evaporate. A drop of suspension containing nonradioactive organisms was placed on uncoated emulsion, and a drop of the radioactive suspension was placed on the Formvar-coated surface of the same emulsion. All biological specimens were exposed on emulsion from 1 to 4 weeks and processed as described above for the tritium standards.

Results. The photographic density of the standards was proportional to the intensity up to densities of at least 0.3 and 0.2 in the case of NTB_3, 50 μ (Lot #458, 371-47), and NTB, 10 μ (Lot #458, 380-47), respectively (Fig. 5). Exposure was expressed as total disintegrations/cm² of surface and was calculated from the counting rate as described above. Beischer observed a similar proportionality in the case of C^{14} up to an optical density of 0.4, using EK No-Screen X-ray Film (*14*). In the case of P^{32}, proportionality was observed by Kaplan (*15*) up to a density of 1.1 for No-Screen X-ray film and 0.1 for EK Nuclear-Track, NTA, emulsions. The particular emulsion lot of NTB_3 mentioned above was found to be more sensitive than NTB, NTB_2, Medium Lantern Slide, and No-Screen X-ray emulsions when measured densitometrically, using the same standards for each. As was expected, the sensitivity of factory-coated NTB_3 was slightly less than that of the uncoated emulsion. Application of a thin layer of 1% Formvar decreased sensitivity slightly. Fairly good linear response in density against intensity was also noted with the other films. Control nonradioactive standards of 11-keto-pregnanolone gave no detectable darkening of emulsion.

Yeast grown in the medium containing tritium gave evidence of radioactivity after a week's exposure. Clusters of yeast showed an image in the radioautograph that corresponded identically with their pattern of arrangement on the slide. Usually a complete silhouette of each yeast cell was given in the radioautograph when organisms were distinct. Individual budding yeast cells are shown (Fig. 2). In some preparations with short development periods variations in the concentration of radioactivity could be observed. Extranuclear concentration was greater than nuclear. Often a differential concentration at the poles or along the periphery of the organism was apparent (Fig. 3). Discrete areas of concentration as small as 0.5 μ were resolved and measured with a filar ocular micrometer calibrated by a standard stage micrometer. Peripheral outlining of the yeast cells 1 grain in width was seen in some specimens purposely underexposed. Control yeasts did not cause reduction when placed directly on emulsions, when placed on a Formvar coat overlying emulsions, or when apposed to emulsion.

Paramecia grown in the medium containing tritium gave well-defined radioautographic images after a week's exposure. Whole organisms on the emulsion were sufficiently opaque to hide the underlying radioautographic image. When the organism was removed, a sharply defined radioautographic image was seen. Emulsions apposed to organism on a glass slide also gave a sharp image.

Sections of paramecia cut at 1 μ gave the best radioautographs (Fig. 1). The sections were thin enough to permit the passage of light through the organism and to reveal the underlying emulsion image. Radioactivity was evident throughout the organisms, both in endoplasm and ectoplasm, with a concentration of activity in the latter. Many discrete round areas of concentration of tritium were present in the endoplasm. Most corresponded to food vacuoles, but a few large areas resembled the macronucleus. The mouth was sharply outlined in some organisms. In

[6] The yeast were prepared and kindly made available by H. Christine Reilly, of the Division of Experimental Chemotherapy.

some preparations, areas of radioactivity between organisms much smaller than the endoplasmic concentrations or the yeast cells were noted. It could not be decided whether these were foci of radioactive debris or organisms.

Since about 90% of the β-particles are absorbed by a thickness of 1.2 μ in a medium of unit density or by a thickness of 0.2 μ in a silver bromide medium, very few β-particles will affect more than two grains. This factor leads to increased resolution. We were unable to observe β-particle tracks from samples containing tritium. Some of the smaller individual yeast organisms gave radioautographic images 3 μ in diameter, and in some organisms extranuclear polar or peripheral concentrations of radioactivity as small as 0.5 μ were resolved. Resolution of less than 1 μ was readily discernible (Fig. 3). This observation was made in a radioautograph which contained a thin coating of Formvar over the emulsion. The image here was not as distinct as in some preparations, where peripheral concentrations were represented by a single-grain outline of the cell wall. Ectoplasmic concentrations of radioactivity in the paramecium disclosed that distinct images of 1-μ size were clearly resolved.

The usefulness of tritium, allied with radioautography, in tracer studies depends on the specific problem under study. Tritium atoms bonded stably to carbon can be used for the labeling of carbon atoms just as deuterium has been used (*16*). The preparation of certain tracer compounds using radiocarbon is sometimes very difficult. In these cases, it may be less difficult to introduce tritium by catalytic reduction of a related compound or isotopic exchange with the inactive compound. For example, the introduction of radiocarbon into the skeletal framework of a steroid compound is considerably more difficult, in general, than the introduction of hydrogen atoms bonded to carbon. Among the general synthetic methods may be included exchange between the organic compound and water, sulfuric acid or hydrogen gas containing tritium, the hydrogenation of a double bond, and biosynthetic techniques involving the culture of organisms in media containing tritium (*17*). The lability of hydrogen linked to oxygen and nitrogen in —OH and —NH_2 and to carbon atoms at sites of enolization must be kept in mind by the investigator.

Tritium has recently been made available by the U. S. Atomic Energy Commission in 100-mc and 1-curie lots at relatively small cost. Its half-life of 12.1 ± 0.5 years (*18*) is more than adequate for radioautographic studies. Its use in human beings requires information about the biological half-life and any specific sites of localization of radioactivity.

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A Method for Initiating the Absorption of Carbon Dioxide during a Manometric Experiment

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When the respiratory quotient of tissues respiring in the presence of carbon dioxide is determined, it is necessary to absorb this gas after the period of metabolism. Many techniques for accomplishing this (*1, 2*) require special glassware, such as the flasks designed by Dickens and Simer (*3*) or by Dixon and Keilin (*4*). Other methods (*2*), adapted for the generation of alkali in the side arm of a Warburg flask, require an extended period of time for the complete absorption of carbon dioxide. The method reported here permits the addition of strong alkali to a filter paper strip in the side arm of a standard Warburg flask with a minimum of special equipment. The alkali, thus distributed throughout the area of the filter paper strip, causes a rapid absorption of the carbon dioxide in the flask.

The apparatus consists of a stopcock (ST 7/22) mounted on a ground-glass connection which fits into the opening of a Warburg flask side arm (Fig. 1). The stopcock contains a well in the form of a groove with a capacity of 0.1–0.2 ml. The well and part of the reservoir may be filled with alkali by inserting the needle of a hypodermic syringe through the reservoir. Care must be taken that no air bubbles are trapped in the alkali of the well. The reservoir is then sealed with a small cork. The stopcock remains in the position for filling until the alkali is to be added to the flask. A strip of filter paper is then fitted into the ground-glass connection so that it touches the stopcock, the remainder of the strip projecting into the side arm of the flask. The apparatus is then inserted into the side arm.

Following a period of respiration, acid is tipped

[1] American Cancer Society fellow, upon recommendation of the Committee on Growth of the National Research Council.
[2] Atomic Energy Commission predoctorate fellow in the biological sciences.

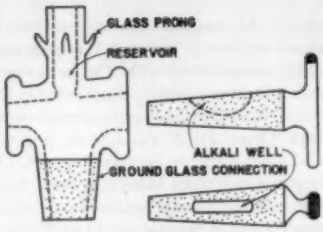

FIG. 1. Apparatus for addition of alkali to a filter paper strip in a Warburg flask side arm.

into the main compartment to stop metabolism and liberate bound carbon dioxide. The center well may be used for storing this acid. After the evolution of carbon dioxide is complete, the manometer is read and the stopcock turned 180 degrees until the alkali well touches the filter paper in the connection. The alkali will then wet the paper strip, absorb the carbon dioxide in the flask, and permit a manometer reading due to oxygen uptake alone. The respiratory quotient may be readily calculated from the two manometer changes and a knowledge of the volume of carbon dioxide originally present in the incubation medium.

For the calculation of volume changes from the manometer readings, it is necessary to use Warburg flasks calibrated with the apparatus inserted. The alkali well should not be included as part of the flask volume in this calibration. The reader is referred to the original papers (*3, 4*) and to standard texts (*1, 2*) for theory and applications.

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The Thromboplastic Potency of Different Morphological Parts of Rabbit Brain

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The thromboplastic materials currently used in blood coagulation studies are generally aqueous suspensions of dehydrated tissues and organs, principally brain, lung, and placenta. Ordinarily, entire organs are used for this purpose, obscuring the possible differences in thromboplastic potency between the morphological parts of the organ. It is the purpose of this paper to present data which indicate that the medullae of male rabbit brains differ significantly from the other morphological parts of the brain in thromboplastic potency.

The materials and methods have in the main been described elsewhere (*1*). For the purpose of this investigation the brain was divided into the following parts: cerebrum, cerebellum, corpora quadrigemini, cerebral peduncle, and medulla. In each experiment, the powders were prepared for extraction and suspension from the pooled similar parts of a dozen fresh rabbit brains.

Normal human oxalated plasma was used. The Quick one-stage method was employed with the following modification: suboptimal[1] concentrations of thromboplastic suspensions were used in order to slow the reaction by deficiency of thromboplastin. Variations in the thromboplastic potency would thus, we believe, tend to be more sensitively reflected in the clotting time.

TABLE 1

PLASMA CLOTTING TIME IN SECONDS WITH THROMBOPLASTIC SUSPENSIONS (0.1 G/10 ML PHYSIOLOGICAL SALINE) OF THE VARIOUS BRAIN PARTS

	Cerebrum	Cerebellum	Corpora quadrigemini	Cerebral peduncles	Medulla
Mean	19.4	20.1	22.1	19.6	33.0
Median	19.4	20.7	21.3	19.7	32.2
Low	16.4	13.3	16.5	15.2	20.4
High	22.2	32.3	34.2	24.3	47.9

The one-stage method was therefore used as a thromboplastin assay instead of a prothrombin test.

The acetone-dried residue of the rabbit brain had a mean dry weight of 1.2 g. Of this, the cerebrum, cerebellum, corpora quadrigemini, cerebral peduncle, and medulla represented 56%, 12%, 4%, 14%, and 12%, respectively. The powders were all cream-colored and had a faint characteristic odor. Insufficient trituration[2] yielded a cork-colored material with granular aggregates, and prolonged trituration produced a very fine, whitish powder. Both the latter products yielded much less active thromboplastic suspensions. The cause for this is not yet known.

Table 1 shows the summarized data of the clotting times of seven sets of preparations of the various brain parts, using 17 different normal plasmas. Each preparation represents the pooled similar parts of 12 rabbit brains. It is seen that the cerebral preparations were generally not only more active, but they also showed smaller variation than any other brain part. Statistical analysis (Student's "t" test) showed that the differences between cerebrum, cerebellum, corpora quadrigemini, and cerebral peduncle were not significant. There was, however, a highly significant difference between the medulla and the other brain parts as a whole ($p < .005$), as well as between the medulla and other brain parts individually.

It was of interest to determine whether the lower potency of thromboplastic suspensions from medulla

[1] By optimal concentration is meant that obtained from the smallest amount of powder/10 ml saline which will yield the shortest clotting time for normal plasma in the one-stage method. In our laboratory this is 0.5 g powder/10 ml saline. It clots plasma in about 11–12 sec. The suboptimal concentration used was 0.1 g/10 ml.

[2] In Waring blendor with acetone.

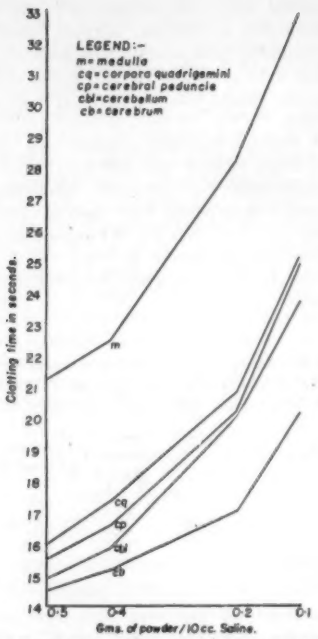

FIG. 1. Comparison of the thromboplastic potency of the various brain parts in different concentrations.

was also evident when greater concentrations of powder were used.

Fig. 1 presents the data obtained with the pooled brain parts of a dozen rabbits used in the various concentrations. It is seen that the clotting times of the 0.1 g/10 ml extracts correspond well to the means of Table 1, and that the difference between medulla and the other morphological parts of the brain is also evident at the higher concentrations of thromboplastic suspensions.

It is too early to attribute general significance to the data presented here; such analyses must await further studies. An immediate result, however, has been the improvement of the thromboplastic preparations used in the prothrombin determination in the clinical laboratory. These are now prepared minus the medulla. Phenol to a final concentration of 0.25% is

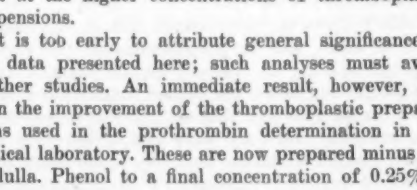

FIG. 2. Comparison of routine control prothrombin times obtained with the former and with revised thromboplastic preparations.

also added to the suspensions to prevent bacterial growth, which seriously reduces the potency of the thromboplastic suspensions (*2*). The behavior of these preparations has been gratifying: activity has been increased, and variation between normal controls has been reduced (Fig. 2). Normal control times range between 10–13 sec and are largely between 11–12 sec. The resulting preparations have also been very stable; large amounts of such suspensions have been kept in the refrigerator for a month, with portions removed for daily routine use, with no apparent deterioration.

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The Viscosity of the System Methanol-Toluene

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The viscosity composition curves of many binary liquid systems have points of inflection, and when the components are of nearly equal viscosity they may even exhibit maxima and minima where the viscosity is respectively greater or smaller than that of either pure component. Such curves have been reported for the systems formamide-isobutyl alcohol and formamide-isoamyl alcohol (*1*).

Viscosity data on the system methanol-toluene at 20° C lead to a strikingly similar curve (Fig. 1). The

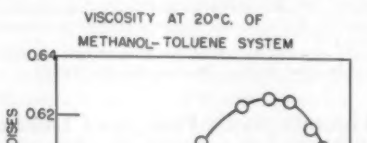

FIG. 1.

density determinations were not precise enough to show whether there is any dilatation when mixing small amounts of methanol with toluene, but showed a definite contraction when the solution contained more than 20 mole % methanol (Fig. 2).

The methanol used for these experiments was Baker's C. P. Analyzed Absolute Methanol, assay (by vol) 99.5%. The toluene was bought from Central Scientific Company and was labeled "Toluene for Technical Use." These materials were purified by

distillation through a Hempel-type column packed with glass beads using a reflux ratio of 3:1.

The viscosities were determined with a Fisher-Irany viscometer, and the densities with a bicapillary pycnometer, as described by Lipkin *et al.* (*2*). The water-bath temperature was controlled within 0.05° C.

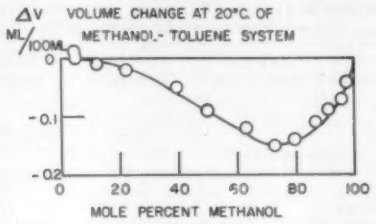

FIG. 2.

The specific heat, heat of mixing, and volume change on mixing of this system at 25° C and 35° C have been studied by Mason and Washburn (*3*), who observed contraction for all compositions and concluded that the associated pure methanol undergoes dissociation when it is dissolved in toluene and that simultaneously there is solvation of the methanol by the toluene.

Similar conclusions were reached by Washburn and Lightbody (*4*) when investigating the volume change on mixing of this system and of other aliphatic alcohols dissolved in benzene or toluene. They also reported contraction throughout the composition range for the methanol-toluene system.

Bushwell, Deitz, and Rodebush (*5*) studied the infrared absorption spectra of methanol and found that the association in concentrated methanol solutions is caused by hydrogen bonding.

Harms (*6*) has discussed the volume changes in this kind of system by assuming that the alcohol exists partly as association polymers of various chain lengths, produced by repeated reaction steps obeying the law of mass action, each reaction step having the same equilibrium constant. According to these views, the observed volume change is the difference between the dilatation caused by depolymerization and the contraction caused by solvation.

The present data show that the viscosity cannot be a function of the volume change alone, but that the reduction in chain length of the association polymers must also contribute to the decided lowering of viscosity when a small amount of methanol is dissolved in toluene.

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Phosphogalactoisomerase[1]

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Caputto and his co-workers (*1*) have shown that the first stages in the fermentation of galactose by the adapted yeast *Saccharomyces fragilis* may be represented by the following equations:

Galactose + ATP ⟶ Galactose-1-phosphate (I)
Galactose-1-phosphate ⟶ Glucose-1-phosphate (II)
Glucose-1-phosphate ⟶ Glucose-6-phosphate (III)

Reaction I is catalyzed by an enzyme, galactokinase, which was separated from the yeast extracts in a partially purified form (*2*). Reaction III is the well-known phosphoglucomutase reaction, which requires diphosphoglucose as a coenzyme (*3*). The enzyme associated with reaction II was not isolated but was detected in the crude yeast extracts by virtue of its requirement for the newly described coenzyme, uridinediphosphoglucose (UDPG). When this coenzyme was added to extracts of the macerated *S. fragilis* cells, an increased rate of formation of glucose-6-phosphate from galactose-1-phosphate was observed (*4*).

In the course of our investigations of the metabolism of galactose in animal tissues we have used the washed cells of *S. marxianis* to remove galactose from tissue extracts and have had occasion to investigate the above reactions with both *S. fragilis* and *S. marxianis*. We have confirmed the essential features of the reaction mechanisms proposed by the Argentine investigators and have extended their observations by the isolation of the enzyme which catalyzes the transformation of galactose-1-phosphate into glucose-1-phosphate. We suggest that this enzyme be named *phosphogalactoisomerase*.

Forty-eight-hr cultures of *S. marxianis*, grown in a yeast extract–galactose media, were harvested and washed with water. The cells were dried *in vacuo* and were then ground to a fine powder. This material was extracted with a phosphate buffer at pH 7.6 and yielded a solution which was rich in the three above-mentioned enzymes. When this extract was acidified to pH 5, a precipitate was formed which was collected and suspended in water. Clarification of this preparation by centrifugation at 8,000 rpm yielded a solution which contained most of the phosphogalactoisomerase but no galactokinase and no phosphoglucomutase.

The enzyme is inactive in the absence of the UDPG coenzyme. However, when this coenzyme is added to a mixture of the enzyme and galactose-1-phosphate, the substrate is converted into a nonreducing phosphorylated hexose which has been identified as glucose-1-phosphate. A typical protocol is shown in Table 1. Since the determinations of glucose-1-phosphate and

[1] This investigation was supported by a grant from the Division of Research Grants of the National Institutes of Health, USPHS.

TABLE 1

CONVERSION OF GALACTOSE-1-PHOSPHATE INTO GLUCOSE-1-PHOSPHATE BY PHOSPHOGALACTOISOMERASE AND ITS COENZYME

Enzyme preparation in the incubation mixture (ml)*	Hexose found after acid hydrolysis†			
	0 min		30 min	
	Glucose (mg)	Galactose (mg)	Glucose (mg)	Galactose (mg)
None	0.07	2.30	0.06	2.33
0.2	.09	2.32	.22	2.17
.4	—	2.37	.34	2.03
.6	.03	2.36	.64	1.78
0.8	.08	2.36	.83	1.58
1.0	0.06	2.37	0.93	1.45

* Each flask contained 4 mg of the dipotassium salt of galactose-1-phosphate (equivalent to 2.0 mg of galactose) dissolved in 1 ml of 0.15 *M* phosphate buffer of pH 6.95. To this was added 0.4 ml of a UDPG solution prepared according to Caputto *et al.* (*4*), 0.1 ml of 0.08 *M* magnesium chloride, the quantity of the enzyme solution indicated in column one, and water to make the volume of the mixture to 3 ml. Incubation temperature was 37.5° C.

† The values for galactose include an increment of nonfermentable material derived from the UDPG.

galactose-1-phosphate require the removal of the phosphate radicals by acid hydrolysis and involve a differential fermentation of the glucose and galactose in the reaction products, all data are calculated in terms of the quantities of these two sugars found before and after incubation. The details of the preparation of the enzyme and the analytical procedures used will be reported elsewhere. The data in Table 1 demonstrate that under the experimental conditions used the rate of conversion of galactose-1-phosphate into glucose-1-phosphate is a function of the amount of the enzyme present in the reaction mixture. The mechanism of this reaction is not definitely worked out, and as yet we have not been successful in demonstrating the presence of the enzyme in animal tissues.

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An Elevated Excretion of Creatine Associated with Leukemia in Mice[1]

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In a previous report we have shown a relationship between creatine excretion and the level of circulating leucocytes (*1*). Monkeys recovering from aminopterin treatment exhibited a marked creatinuria, the peak of which corresponded approximately with the point of maximum white blood cell response. Other experiments have indicated a relationship between methyl donors and white blood cell formation (*2, 3*). The present report presents data which show that leukemic mice exhibit a marked creatinuria.

[1] Research paper No. 961, Journal Series, University of Arkansas. This work was supported by a grant-in-aid from the American Cancer Society upon recommendation of the Committee on Growth of the National Research Council.

TABLE 1

CREATINE CONTENT OF URINE AND SKELETAL MUSCLE FROM CONTROL AND LEUKEMIC MICE

	Urinary creatinine (mg/100 g body wt/day)	Urinary creatine (mg/100 g body wt/day)	Muscle creatine (mg/100 g)
Control	1.8	2.6	371
Leukemic	2.1	9.4	361

Mice of the DBA strain, line 2, were used, and leukemia was induced by blood transfer. Approximately 0.1 ml of blood from a leukemic donor was inoculated intraperitoneally into the recipient. We have consistently found that mice so treated develop characteristic blood changes 8 or 9 days following the blood transfer and die in 9–12 days. There are characteristic tissue changes at the site of inoculation. In the first experiment, 4 leukemic mice taken 10 days after blood transfer and 4 control mice were placed in metabolism cages. A single pooled 24-hr urine sample was analyzed for creatine and creatinine (*4*). The animals were then sacrificed, and the creatine content of samples of skeletal muscle was determined. In a second experiment 10 mice were placed in metabolism cages immediately after blood transfer, and creatine and creatinine (*4*) and allantoin (*5*) were determined daily on appropriate urine aliquots. Creatine/creatinine, and allantoin/creatinine ratios were calcu-

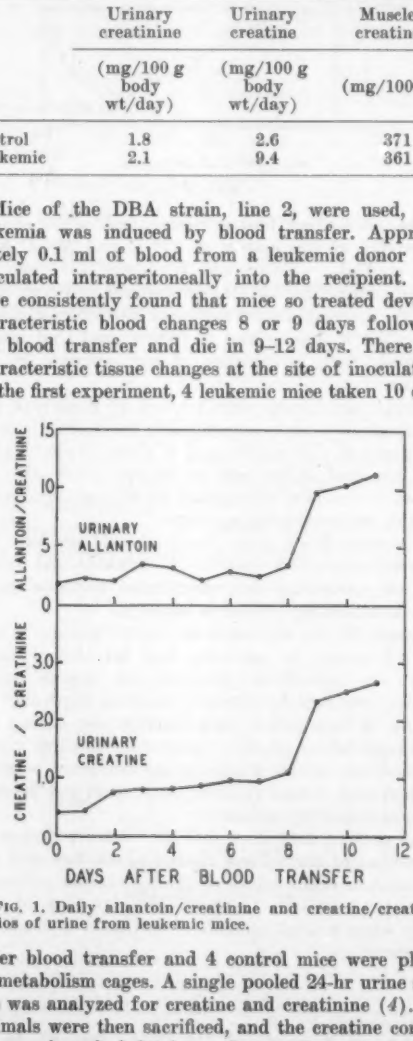

FIG. 1. Daily allantoin/creatinine and creatine/creatinine ratios of urine from leukemic mice.

lated, since creatinine excretion was found to be constant.

The data presented in Table 1 show that leukemic mice excrete large amounts of creatine compared to control mice of the same strain. Creatinine excretion was not significantly different between the two groups, nor was the content of muscle creatine.

Typical results obtained by daily measurement of creatine and allantoin excretion by leukemic mice are presented in Fig. 1. The average survival time after blood transfer was 10–12 days. It may be seen that, beginning about 8 days after blood transfer, there was a marked increase in creatine/creatinine and allantoin/creatinine ratios. Elevated allantoin excretion occurring during leukemia is not a new finding. The elevated creatine excretion occurring during leukemia in these mice quite probably reflects an increased synthesis of creatine, since the content of muscle creatine was not significantly different between the two groups and there was not a net weight loss. These results in conjunction with those previously cited (*1–3*) suggest that creatine may play a significant role in white blood cell formation.

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Comments and Communications

Science Education as an Ambassador of Good Will

The exchange of educational facilities with some of our Latin-American neighbors, which has received active support through various exchange fellowship and professorship programs, has reached the point where some of the reactions of our colleagues to existing arrangements may be evaluated. The author has discussed the problem both with prominent educators, such as the presidents, deans, and professors at various South and Central American universities, and with students who were actual or potential candidates for such exchanges. Although it is not possible to present the entire picture in one brief note, a few of the reactions are worth reporting.

The vast majority of persons agreed wholeheartedly with the major premise—namely, that great benefits could accrue to Latin America through the wider dissemination of technical education and information. The questions revolve around the best means of attaining this end, and we shall review some of the pertinent considerations that were pointed out by our Latin colleagues, not all of which are fully appreciated in the northern countries.

First must be stressed the need for a broad technical education rather than a too-narrow specialization. It does no good to train a man to be an expert in the use of a particular instrument if no instruments of this type exist in his homeland; or to be an outstanding authority on a disease that occurs but rarely in his community. Yet, in the U. S. our tendency is to specialize and to reward the specialist. Thus, in graduate training particularly, a grave responsibility rests on the officer in charge, to avoid the temptation to assign one more graduate student to an intricate discipline, of which very few units exist in the entire world. The more valuable training would consist in a broad background in the subject, in the methodology of research, and in self-sufficiency and improvisation to build the necessary apparatus out of parts locally obtainable. It is always a temptation to draw ready-made equipment from the stock room, but this procedure is clearly undesirable when ready-made equipment would have to be purchased abroad at a considerable national sacrifice in foreign exchange. The success of the various European nations in making very complex apparatus and, indeed, in starting small industries is encouraging in this regard. We may cite Sweden as an example with a population of approximately 6,900,000 persons—less than that of greater New York—which has its own electronics industry, and which has constructed a large cyclotron almost entirely out of Swedish parts and materials.

The many advantages in sending students from Latin America to U. S. schools need hardly be catalogued; they can receive good training at many centers. The disadvantages to the Latin nations must also be considered. All too often the best students stay in the U. S., where they find good employment opportunities. This results in a gain to the U. S., but a larger loss percentagewise to the country that sent the students. The loss is doubly great if the country had to dip into its supply of foreign exchange to finance the fellowships. The second disadvantage has already been cited. U. S. tendencies in graduate training are commonly so specialized as to prepare a man better to be part of a complex entity here than to take the lead in the less technically advanced situation in his own country.

Exchange professorships, which are so successful among technically advanced countries, run into a serious drawback: What is there that can be offered in exchange? Seldom will a Latin country have a good technically trained professor to offer, but we might urge that professors of Spanish be occasionally sent, for this language is often taught in the U. S. by persons with atrocious accents and with no knowledge

of South American usages, insofar as they differ from those of Spain.

The chief objective of exchange programs can be achieved by sending more Spanish-speaking American professors to Latin America than has thus far been done. Professors in almost any technical subject, the sciences or engineering, are especially welcome. The person selected should speak Spanish; or if he does not, he should be willing to learn. Although almost all educated Latins speak several languages, the possibility of getting education across to students is far greater in the professor's poor Spanish than in English, which is too imperfectly comprehended. The financial problems in such a program do not seem to be insuperable. American universities have in the main generous policies regarding leaves, sabbaticals, or retirements. American professors could augment their leave, sabbatical, or retirement allowances by payments for a part-time teaching load in South America, where living costs are generally less. If, to this, could be added grants from the State Department, Unesco, or private organizations, a very considerable visiting professorship program could be activated. At present, it is most effective if the individual professor makes direct arrangements with the university in the country he considers the most interesting. When conducting such negotiations, the American should bear in mind that, although a given country can be generous in the salary it may offer, it may be difficult to secure any appreciable number of dollars, even to the extent of paying for an international air ticket.

The Latin-American universities urgently need technical books, journals, and other publications. Before World War II, large numbers of European books—mainly French and German, and occasionally English—found their way to the shelves of South and Central American libraries. They cost less than American publications. Today this source has largely dried up, and yet American books are still as expensive as ever, or more so. An American text, costing $7.00 to $9.00 U. S., by the time shipping costs are paid and the resultant sum is translated into a currency that has perhaps depreciated to one third its prewar value, becomes an impossible burden for the library and the student alike. In the meantime, the total quantity of technical information has so greatly increased that new books on every phase of technology are constantly appearing. The resulting gap in the book and journal situation in Latin America has greatly enhanced the difficulties in setting up adequate technical training programs. A tremendous market awaits the enterprising firm or individual who can find an inexpensive way of supplying the demand for technical books, journals, and other publications.

In the meantime, it is to be hoped that free lists will be expanded, that exchanges will be activated, and that individuals in charge of book distributions will realize that a great need, amounting to an acute hunger, for such books exists. It is further to be hoped that, in making up gift or exchange lists, not merely the few large universities at populous centers be included, but also the smaller provincial universities as well. The latter are often more concerned with education and less with politics than certain of the larger institutions.

Finally, it may be hoped that further distributional activities will be undertaken by the State Department or Unesco. The value to the countries receiving such exchanges or gifts is enormous, and from a purely selfish viewpoint, the value to the United States will be incalculable, not only as a gesture of good will but as first-class advertising. American texts describe American industrial products and equipment. What will be more natural than for an engineer or technical man, who desires to construct or buy a machine or piece of equipment, or to secure apparatus for a research project, than to order such items and parts as he has seen described in the books with which he is familiar? There seems little doubt that the cost of books distributed free or at a nominal price will be but a small fraction of the business that will accrue in the form of orders placed. Such was the European experience in the twenties and thirties, and it would indeed be a shortsighted policy if we were not ready to take advantage of the great technical awakening that is about to take place to the south of us. The author does not mean to encourage exploitation, but we should assist Latin-American nations in every way to achieve a technical proficiency that will help both them and us and that will, as has been so abundantly demonstrated, raise the standard of living of all countries concerned.

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The Glomerular Ram and Renal Water Absorption

CAPABLE physiologists and mathematicians have analyzed the hydrodynamics of renal blood flow and have been puzzled by the apparent deficit in pressure available to propel urine at the rates known to exist (BRODIE, T. G. *Harvey Lectures*, Ser. 5, 81 [1909]; WINTON, F. R. *Physiol. Revs.*, 17, 408 [1937]). D. Gomez, in the most sophisticated analysis (*Rev. sci.*, 3272, 451 [1947]), realized the importance of the elastic properties of the glomerulus but failed to grasp that it represents a coupled elastic ram, capable of elevating the pressure of glomerular filtrate as much as ten times that of the afferent arteriolar pressure by momentum transfer.

Such high pressures have been known to be extremely destructive in conventional hydraulic rams (ANDERSON, E. W. *Proc. Inst. Mech. Engrs.*, 1, 337 [1922]), and they may play a significant role in the destruction of tubular tissue in hypertension.

More interestingly, however, such high pressures afford a simple, self-regulating, and continuously variable control for water reabsorption in the nephron and explain many apparent paradoxes in clinical renal physiology. Complete solution of the equations, because of variable viscosity terms, requires analog

solution, now under way. The limits of the device are entirely dependent on the ratio of the as yet unknown elastic constants of the glomerulus, whose direct measurement is now being attacked.

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Science and the Bible

SCIENCE is not intended to be a forum for theological disputations. It is therefore most surprising and regrettable that valuable space was ceded to the comment by Cyrus N. Ray (SCIENCE, **113**, 610 [1951]). To a physician and scientist like myself, who is acquainted with Hebrew philology, as well as classical literature, that diatribe reveals an imperfect and prejudiced acquaintance with the Book of Books. His citation from Rev. 7: 1 is but a repetition of a well-known classical Hebrew expression found in three passages of the Hebrew Bible; namely, Isa. 11: 12, Isa. 24: 16, and Ezek. 7: 2. In each case the Hebrew term *Kanaf* is employed (pl., *Kanfoth*), which etymologically denotes "wing or wings," and the expresion *arba Kanfoth ha-aretz* refers not to the shape of the earth but to the four points or directions of the compass. By "four corners of the earth" is meant, as the Authorized Version correctly puts it, the "uttermost parts of the earth" or, as the Vulgate gives it, "four quarters of the earth" (Douay's translation).

The passage in Isa. 40: 22, so well quoted by Carl S. Wise (SCIENCE, **113**, 128 [1951]), is the clearest and the absolutely unequivocal Hebrew reference to the shape of the earth. The Hebrew *Hug* means a circle and refers to the round contour of the earth. Some Hebrew scholars interpret that verse as referring not only to the spherical shape of our planet, but also to the earth's orbit. The clause in the same verse (Isa. 40: 22) that reads, "And her inhabitants are like grasshoppers," in Hebrew does not refer to the small size of man in the eyes of God, who is all-seeing and omniscient. On the contrary, it describes with exquisite aptness the psychology of *Homo sapiens* by comparing him to the grasshoppers of the Bible. The characteristics of these creatures are delineated in three passages. In Joel, chapter 1, they are described as voracious and noisy. In Eccles. 11: 5, they are depicted as frequently dominated by overwhelming sex drives (the Hebrew *hagab* denotes *libido*; compare Rashi's commentary). In Num. 13: 33 they reveal an exaggerated inferiority complex (compare Midrash on Shir Hashirim).

Voluminous concordances and extensive commentaries have been written on the works of Shakespeare, Dante, Goethe, and other great writers. So have numerous concordances and commentaries and lexicons been devoted to the Tenach, or Hebrew Bible. Shall we deny the same homage and study, even from the purely literary point of view, to the universally acclaimed poets, prophets, philosophers, and preachers of the Holy Writ? The answer given by those men of science who have had sufficient breadth of vision and initiative to master the humanities along with their store of scientific lore, those men who live a three-dimensional life instead of the flat, two-dimensional one of the specialist, is unequivocal.

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Far Vision Observations

Two discussions of the limits of unaided human vision of topographical features at a distance of 13 miles, by Hirsch and Weymouth, and by Olmsted and Olmsted recently appeared in SCIENCE (**114**, 19 [1951]). The writer doubts the contention of Hirsch and Weymouth that "a cliff less than one foot in height could be recognized as a change in contour at a distance of thirteen miles." My field experience indicates that no such visual acuity exists under natural conditions.

My office windows in the Mims Building, Abilene, Texas, offer a vantage point from which objects may be viewed at a distance of 13 miles. Almost the whole south horizon is rimmed by escarpments of the Callahan Divide of the Edwards Plateau. One of these, Cedar Gap Mountain, rises 569 ft above Abilene, and on its top is a radio tower (KRBC) that rises an additional 456 ft. My position for observation is 80 ft above the street, and on clear days the radio tower may barely be seen like a very dim pencil line on paper. The radio tower has a bright sky background above and back of the mountain on which it stands, or it probably would be invisible at that distance.

The structure is composed of three steel rods, each 2 1/6 in. in diameter, set in triangular form, and joined by a lattice of short rods to form the tower, inside of which is a narrow metal ladder. Each of the three flat faces of the tower is 50 in. across. Evidently, at a distance the 50 in. of lattice have about the visual appearance of a solid of that size.

If this steel tower 456 ft tall and 50 in. wide can be only faintly seen as a dim pencil-like line against a brilliantly lighted sky at a distance of 13 miles, it seems improbable that an offset of one foot in an escarpment face would be visible at that distance.

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Book Reviews

Bernhard Eduard Fernow: A Story of North American Forestry. Andrew Denny Rodgers III. Princeton, N. J.: Princeton Univ. Press, 1951. 623 pp. $7.50.

In completeness of coverage, fidelity to facts, and freedom from bias, this volume should rank as the most comprehensive and trustworthy history of the origin and development of forestry in the U. S. and Canada that has yet appeared. The author has made a thorough examination of all published records and has supplemented these data drawn from extensive private correspondence and personal interviews. In a careful reading of the text, based on personal knowledge covering fifty years, the reviewer has not discovered any inaccuracies.

Bernhard Eduard Fernow, as the record shows, was truly the founder of the profession of forestry in America—despite the fact that Gifford Pinchot, his successor as head of what was then the U. S. Bureau of Forestry, building on the foundations Fernow had laid, was able to realize the aims of his predecessor. With the support of President Theodore Roosevelt, Pinchot established and greatly expanded the national forest areas and policy for which Fernow was responsible.

The practice of forestry as a science and an art was unknown in America when Fernow first visited this country in 1876 to attend the Philadelphia Centennial Celebration. Remaining here, he later married the American girl who was the real reason for his transfer of citizenship. A Prussian of the old school, he had received a complete education and training in the science of forestry in his native land. With this equipment he combined keen intelligence, great versatility, enormous energy, and the culture and instincts of a gentleman and a true scientist.

Fernow was appointed chief of the Division of Forestry in the Department of Agriculture in 1886—his first salaried position in forestry—after a decade of employment in other fields and of active public work for a sound national forest policy. By June 4, 1897, his plan for national forests had been adopted by Congress and a sound administrative act passed and, with Filibert Roth, he had founded the science of timber physics.

Not by nature politically minded, Fernow in 1898 resigned to found the first professional college of forestry in the U. S. at Cornell University, to prepare students for the practice of this art, then for the first time promising employment to trained men. His later misfortune, brought about by his belief that plantations of conifers should supersede Adirondack hardwoods, which led to temporary discontinuance of the school in 1903, is ably and fully covered and should be accepted as the last word on this controversy.

After a year of substituting at the Yale School of Forestry in the absence of Henry S. Graves in the Philippines, Fernow initiated the College of Forestry at Penn State, in 1905, but in 1906 he was called upon to found the College of Forestry at the University of Toronto—where he remained until his death in 1923. His influence on Canadian forestry was as far-reaching and profound as had been his initial efforts here.

This text is far more than a life of Dr. Fernow. Literally hundreds of persons are mentioned, with the part they played in forest history. All important events in the development of forest policy and practice are accurately dealt with, from the early beginnings of the movement in the 1870s until 1923, when Fernow's participation was terminated by his death.

"To be first in the field in point of time, and to continue to be first in the field in point of quality, is one of the rarest things in this world" sums up Dr. Fernow's career in the words of President Livingston Farrand, of Cornell University, at the dedication of Fernow Hall in 1922.

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Progress in the Chemistry of Organic Natural Products, Vols. VI and VII. L. Zechmeister, Ed. Vienna: Springer-Verlag, 1950; distributed by Walter J. Johnson, New York. Vol. VI: 392 pp.; $12.50 paper, $13.50 cloth. Vol. VII: 330 pp.; $12.00 paper, $12.80 cloth.

It is difficult for a modern chemist to conceive that there was a time, almost within the memory of living men, when a person could know all the important discoveries of organic chemistry. As our science broadens, the task of organization and assimilation continually becomes more complex, and the need for books such as these is felt more keenly. This reviewer is once more impressed by the high scholarship and clear expression of the authors and the intrinsic interest of the subject matter. The work of typesetting and proofreading is beyond praise when the trilingual (English, German, French) nature of the books is considered.

Volume VI deals with "Biochemical and Nutritional Aspects in Fat Chemistry," by H. J. Deuel, Jr., and S. M. Greenberg; "Animal Odors and Perfumes," written in French by E. Lederer; "Occurrence and Biochemical Behavior of Quinones," written in German by O. Hoffman-Ostenhof; "Cactus Alkaloids and Some Related Compounds," by L. Reti; "Plant Proteins," by James Bonner; and "Spectrochemistry of Fluorescence of Biological Products," written in French by Ch. Dhéré.

Volume VII discusses "The Constitution of the Triterpenes," written in German by O. Jeger; "Constitution, Configuration and Synthesis of Digitaloid Aglycones and Glycosides," in German, by H. Heusser; "Thyroxine and Related Compounds," by C. Niemann; "Penicillin and its Place in Science," by A. H. Cook; "The Active Principles of Senna," by A.

Stoll and B. Becker; and "Some Recent Developments in the Chemistry of Antibodies," by J. W. Williams.

The authors give bird's-eye views of these subjects, in which each is an active and well-known worker. The chapters are replete with interesting facts and generalizations. Many excellent suggestions for future work are to be found here. For this reason, these volumes are particularly recommended to the young academic researcher who has not yet selected his particular field of investigation within the vast domain of organic chemistry. Literally thousands of references help to introduce the reader to the original literature.

This reviewer can only congratulate the editor upon being able to persuade busy men to devote so much time to make it easier for the rest of us to catch glimpses of fascinating researches outside the areas of our own efforts. These books are not light reading, but they are very rewarding.

H. B. Hass

General Aniline & Film Corporation

Structural Geology of North America. A. J. Eardley. New York: Harper, 1951. 624 pp. $12.50.

"The purpose of the book is to describe the structural evolution of the North American continent in post-Proterozoic time." The author thus defines scope and aim and faithfully adheres to his purpose. The book is less a structural geology than a post-pre-Cambrian tectonic history and regional geology of North America. The only other recent regional geology of the continent (Bornträger, Berlin) has become a war casualty. This book fills a large gap and, being the work of one author, has all the advantages of single authorship. Disadvantages are well compensated by frequent use of the literature and the many unaltered original illustrations.

The book begins with a brief chapter on definitions of those terms that the author felt needed clarification. There follows a brief summary of the tectonic and paleogeographic history, vividly illustrated by 16 color plates outlining the distribution of orogenic belts, areas of erosion, ocean basins, and areas covered by thin sediments or shallow sedimentation. Lands rise and subside, oceans recede and transgress, and the instability of the earth's crust is reflected in sedimentation and folding of zones at the margin of an otherwise little-changed continent.

From page 24 on the author takes up the structural provinces in 31 chapters, each dealing with an area or tectonic unit. The delineation of units may be debatable but does follow generally accepted lines; it is structural where units are recognizable—for instance, the "Idaho batholith"—or geographical where the units are less defined—for instance, "Alaska." It would seem more desirable to use tectonic units only.

In each chapter the stratigraphy is summarized rather thoroughly, and the structures are discussed in terms of the tectonic history, thus providing a geologic picture of the area. The book is much more than the outline and description of the tectonic evolution of North America. Since it is profusely illustrated (343 figures!), and the illustrations are largely copies of original drawings, it provides the most illuminating document on a theme that one might well entitle: "Geologists at work in North America." It is easy to see how the various authors try to communicate their ideas and conclusions to the fraternity. Easily recognized are professional drawings of draftsmen of the U. S. Geological Survey, too similar to reveal the author's originality. Outstanding are the artistic masterpieces of Phil King, Robert Balk, or the famous block diagrams of Johnson. Some of Raisz's and Lobeck's illustrations appear like antique etchings, but much is left to the lettering set and draftsman where the author should have done the drawing himself. But pictures express ideas. Some of these are conservative and meticulously supported by evidence, others sweeping and with little basis in fact or entirely hypothetical. All follow one another and convey the impression of a busy group of productive scientists.

The text is, of course, entirely the author's, but the ideas and skill as they appear in the illustrations tell the story in a much more lively and authentic fashion—as if the illustrations had lost their identity in the process of publication.

The book is large—624 double-sized pages, and represents an enormous amount of hard work. It is useful as a source book and will be so used by most geologists. For the teacher it will pave the way to many a lecture without search through a library. It will stimulate teaching of regional geology, which is too rarely listed in university catalogues.

It could be expected that not all regions would be equally well handled and that those the author knows fare better than others. For geologists there is no substitute for personal acquaintance in the field.

After receiving the gift of the author's many years of labor, it seems ungrateful to criticize it and to ask for more and greater efforts, but the complete omission of the basement structures on which the continent is built, and on which the author's work rests, is like building a monumental structure without a foundation. Could it be that this omission reflects lack of information on the basement and possibly lacking interest of the fraternity in crystalline rocks generally?

The outer form of the book is elaborate; the printing and illustrations are first-class and could scarcely be improved.

Ernst Cloos

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The Johns Hopkins University

Genetics: A Survey of the Principles of Heredity. A. M. Winchester; Bentley Glass, Ed. Boston: Houghton Mifflin, 1951. 371 pp. $5.00.

The great majority of students in an elementary genetics course have no special aptitude or interest in the subject and have no intention of going further in it. This book is written for such a group. In his preface the author states: "The material is presented with the

frank intent of arousing the interest of the student and of maintaining it throughout." This is done in several ways: (1) Many of the illustrative examples are chosen from human genetics; (2) the diagrams are striking and the photographs unusually eye-catching; (3) most chapters begin with an anecdote, a bit of folklore, or a human interest story calculated to entice the reader on to the general principle that follows; (4) as far as possible, the book is written in the language of the layman.

There is a rather full account of genetics history, unique in that it includes some of the remarkable doings of Maupertuis. The order of presentation is such that a description of chromosome behavior, including mitosis, meiosis, alternation of generations, and double fertilization in higher plants, precedes, and provides a background for, the discussion of Mendelism. Some of the best human-interest writing is in the chapters on sex determinations, sex differentiation, and sex-related inheritance. (However, the author himself performs the most striking sex reversal when he refers to V. R. Phelps as "he.") I like the three chapters on mutations and the effects of radiations, patterned somewhat after the writings of H. J. Muller. The student is made to realize the importance of environment in conditioning the expression of genetic characters, and has his attention called to the currently popular fields of biochemical genetics, cytoplasmic heredity, and the genetics of microorganisms. The book ends with a survey of human hereditary traits and a moderately full discussion of eugenics.

To me the weakest points are the discussions of quantitative characters, population genetics, biometry, and agricultural applications. The Hardy-Weinberg rule is put in rather as an afterthought late in the book, and there is no quantitative discussion of selection and inbreeding. These may limit the utility of the book for genetics courses in agricultural colleges. I would prefer to have the Fisher theory of Rh factor inheritance at least mentioned along with Wiener's. There are a few minor slips and misprints, of which the most glaring is a diagram on page 178 which implies crossing over in both sexes in *Drosophila*.

The book seems to me to be oversimplified, but that is for the student readers to decide. It will leave many questions unanswered for the serious student, and unfortunately there is no system of references to direct him to more information on those points where his curiosity has been so effectively aroused. The book is not written for the serious student, however. Furthermore, it sets a new standard in interest appeal in a textbook, and as such should be a real contribution to the effective teaching of genetics.

JAMES F. CROW

Department of Genetics and Zoology
University of Wisconsin

Association Affairs

New Prize in Sociology

THE AAAS announces a prize competition for essays reporting upon inquiry into theoretical sociology. Amount, $1,000.

CONDITIONS OF THE COMPETITION

A. It is expected that the essays submitted will strive toward a scientific account of the behaviors of human beings, psychologically and sociologically, in their global setting.

B. Contestants should avoid the descriptions of sociological events in terms of conventional and fictional components derived from everyday speech.

C. To be avoided also are statements derived from traditional philosophies which represent only self-created descriptions projected into the social life of people in the guise of objective interpretations.

D. Since it is the goal of the competition to further the comprehension of the psychological and cultural behavior of persons in current society, it is desirable that the descriptions and interpretations be derived from actual sociological situations. Established knowledge bodily transferred from even the nearest and best oriented sciences cannot substitute for sociologically interpreted findings.

E. As concrete suggestions for the study, it is hoped that entrants will aim at sociological constructs to parallel those that have proved so useful in the biological and physical sciences—for example, particles and waves in physics, blood "milieu" in physiology, genes in genetics.

Manuscripts, which will be judged by a committee of three persons selected from those interested in the field, should be sent to Howard A. Meyerhoff, Administrative Secretary, American Association for the Advancement of Science, 1515 Massachusetts Ave., Washington 5, D. C. In order that the judges may be impartial, the name of the author should be omitted from the typed copy.

The committee reserves the right to withhold the prize if no worthy essay is submitted.

The donor is willing to offer the prize in 1951 and to continue it on an annual basis for three more years. This year, in view of the lateness of the date, consideration will be given to articles published during the year, provided they meet the conditions stated above. Ordinarily, preference will be given to unpublished manuscripts. To qualify for the 1951 prize, manuscript material should be in the hands of Howard A. Meyerhoff not later than *Dec. 3*.

News and Notes

Heerlen Congress on Carboniferous Stratigraphy

THE Third Congress on Carboniferous Stratigraphy and Geology met in Heerlen, Netherlands, June 25–30. More than 200 scientists from 14 countries attended. Individuals and societies from a number of other countries registered or sent papers but were not present.

A. A. Thiadens, president of the congress and director of the Geologische Bureau of Heerlen, which sponsored the meetings, presided over the opening and closing sessions, and W. J. Jongmans presided over the round-table conferences. These two and several other polylinguists contributed much to the integration of the meeting and the amicable atmosphere.

Nearly 100 papers were read in stratigraphy, paleogeography, sedimentology, paleontology, and applied geology. No more than two meetings met concurrently, and they were usually of such diverse nature that those attending could hear all papers in which they had a basic interest.

General lectures were given by W. J. Jongmans, honorary president of the congress; J. J. Lam, Leiden; J. Doeglas, Wageningen; and Dr. Thiadens. Nearly all other papers were limited to 20 minutes each, with an additional 10 minutes for discussion. With few exceptions this schedule was adhered to by the speakers. French, English, and German were the three official languages used. The president of each session encouraged discussion, most of which was recorded immediately by the contributors themselves. Thus a record of the discussions, though not verbatim, is available for inclusion in the *Compte rendu* of the congress.

Eighteen papers in paleontology were nearly equally divided among paleobotany, palynology (fossil spores, pollen, etc.), and paleontology. Seven papers on cyclical sedimentation and 11 on coal origin and petrography constituted most of the program in sedimentology. Stratigraphy of the Carboniferous aroused considerable interest, with 11 papers on the boundaries of the Pennsylvanian and 10 on regional geology. Fifteen miscellaneous papers were given in tectonics, water and gas, applied coal petrography, and geophysics, and 4 in paleogeography.

Professor Jongmans presided over two of the three round-table conferences—stratigraphic delimitations and nomenclature of the Carboniferous, and discussion of palynological nomenclature and publications. At the conference on limitations and nomenclature of the Carboniferous, the recommendations that the Carboniferous be divided into two systems, the Mississippian and Pennsylvanian, met with considerable opposition. This proposal, supported by a majority of geologic organizations and specialists from the U. S., was presented to the congress by James Steele Williams at the request of the American Commission for Stratigraphic Nomenclature. Because of the spirited and nearly unanimous denunciation of the proposal by the European participants, an alternative and compromise proposal was introduced by M. K. Elias, of Nebraska. As it was finally written into the recommendations to be sent to the next International Geological Congress (Algeria, 1952), the term "subsystem" would be introduced into the stratigraphic nomenclature, and the Carboniferous would be divided into two parts called sub-systems.

The conference on palynology, attended by more than 50 persons representing most countries actively engaged in such research, reached several conclusions. Megaspores and microspores are to be treated as species, and such species can be united in genera and families. Other recommendations dealt with standardizing the size of magnifications in publication ($\times 50$ for megaspores; $\times 250$ for microspores) and formulation of names (the name should include an indication that a spore is being dealt with and should not imply relationship to other plants).

Several resolutions were passed at the conference on coal petrography. Additions to nomenclature established in 1935 were made, including massive micrinite, granular micrinite, and sklerotinite. Some terms are to be considered as incompletely defined. A recommendation was made that investigators attempt to gather more data on the reflectivity methods to resolve the present impasse in the use of this characteristic because of the contradictory results between the Berek photometer and photoelectric methods. A further recommendation that a committee on petrographic nomenclature should be established and should meet every two years has been partially carried out by the formation of such a committee, organized by R. Potonie, E. Stach, and the writer, on July 13, in Krefeld.

Mines were visited, and specimens collected on the final day, and a two-day sedimentological excursion to the vicinity of the Hague was conducted following the close of the conference.

At the opening session, the newly established Waterschoot van der Gracht medal for outstanding contributions to geology was awarded to W. J. Jongmans for his long service with the Geological Bureau and outstanding contributions to the international integration of Carboniferous stratigraphy. Professor Jongmans initiated the Heerlen Congress on Carboniferous Stratigraphy in 1927.

An extensive display of reconstructions of ancient life and landscapes from many sources was assembled in the corridors and balcony of the general meeting place, the fine new town hall of Heerlen. A 47-page explanatory guide was prepared for this most unusual exhibit. The collections, library, and facilities of the Geologische Bureau of Heerlen were open to the inspection and use of the participants.

Several papers were presented by Americans, in-

cluding James Steele Williams, the official U. S. delegate, Maxim K. Elias, Irving I. Breger, and the writer. Jack A. Simon read a paper for H. R. Wanless. Dr. Williams represented the U. S. Geological Survey, the American Society for Stratigraphic Nomenclature, and the Geological Society of America. The writer represented the Paleobotanical Section, Botanical Society of America, and, together with Mr. Simon, the Coal Geology Committee of the Society of Economic Geologists. Other Americans attending included J. P. Messervey, Deputy Minister of Mines of Nova Scotia, Wayne L. Fry, Cornell University, and Miss A. Karstrom, Illinois Geological Survey.

Physical arrangements for the participants and their accompanying guests, and the receptions by the state and city officials, were excellent. The cordiality will long be remembered.

AUREAL T. CROSS
West Virginia Geological Survey and
West Virginia University

The Oxford Conference on Low Temperatures

IN connection with the first postwar meeting of the Institut International du Froid (I.I.F.) in London, it was decided to hold the conference planned for 1951 by the Unesco Commission for Very Low Temperatures in Oxford during the week preceding the I.I.F. meeting. The Oxford Conference was attended by more than 200 physicists. The largest delegations from outside the United Kingdom were the Dutch and American, each numbering 35 people. One of the Japanese participants was delayed by a typhoon but arrived in time to give his paper on the last day of the sessions.

It had been the intention of the organizers of the conference to give younger physicists a chance to take an active part. As a result, the program became rather too heavily loaded with short papers. Apart from three longer, introductory contributions, there were more than 100 shorter papers distributed over ten meetings. The first two sessions dealt with thermal properties; the third, with resistivity; sections 4 to 6, with the properties of liquid helium; sections 7 and 8, with supraconductivity; and the last two, with magnetism.

The three longer papers were given by Bleaney (Oxford), F. London (Duke), and Fröhlich (Liverpool). Bleaney reported on recent advances in paramagnetism, and London reviewed the present state of the two-fluid theory of liquid helium, which he showed cannot be understood until a molecular theory of liquid helium is worked out. In the meantime, Simon (Oxford) asked whether it would not be possible to restate Landau's theory in intelligible language, since it seems to fit practically all experimental data. Frölich's paper dealt with his theory of supraconductivity, which appears to be another instance where a first approximation provides the correct answer, but where higher approximations may well be worse than the first one. It may be that the theory of semiconvergent series will play an important role in future theoretical physics. After Frölich's talk, Schafroth (Zurich) showed how one could obtain the London equations from Fröhlich's theory by using gauge-invariant methods. Pippard (Cambridge) pointed out that, although all theoretical physicists try to obtain London's equations from their model, he has obtained experimental evidence from radiofrequency work for the breakdown of the London equations.

In the same session (supraconductivity), Maxwell (N.B.S.) reported that for tin the critical temperature varied with the isotopic mass as $M^{-\alpha}$ where $\alpha = 0.486 \pm 0.031$, in agreement with Fröhlich's theory which predicts $\alpha = \frac{1}{2}$. For lead, however, Olsen (Oxford) found that insofar as T_c could be said to vary as $M^{-\alpha}$, α should be equal to 0.73. Experimental evidence for the existence of spatial, long-range order in supraconductors was given by Pippard. The ordered domains should contain about 10^{10} atoms.

In the session on thermal properties, Abraham (Argonne) reported on the work on the melting curve of He^3 using the blocked capillary technique. These measurements have now been extended down to a few tenths of a degree, and below 0.5° K the melting pressure seems to approach a constant value, indicating a possible transition in the liquid phase. The experimental uncertainty is still too large, however, to arrive at any definite conclusion at this stage, and experiments are continuing.

The sessions on liquid helium started with a survey of recent work in the Royal Society Mond Laboratory by Atkins (Cambridge), who showed that recent measurements on the velocity of first sound and on flow through wide capillaries could not be explained on the basis of the Gorter Mellink two-fluid theory. An additional result of the first sound measurements was that the Landau relation between first and second sound velocity at absolute zero, which seemed to be verified by Osborne's experiments, is not exactly obeyed. However, the experiments are not so conclusive as not to leave a safe margin for doubts. Jackson (Bristol) reported on an optical method for determining the thickness of helium films. A beam of polarized light is reflected by a polished surface. The difference in setting of the nicols between the experiment with and without a helium film on top of the polished surface then gives the film thickness. Heer (Ohio State), Sommers (Los Alamos), Taconis (Leiden), Beenakker (Leiden), and Lynton (Yale) all reported on different experiments involving solutions of He^3 in He^4 and the influence of the He^3 on vapor pressure, fountain effect, and other properties. On the whole, the discussion on liquid helium left one with the impression that no satisfactory theory exists to explain the experimental data. Especially, the marked difference between He^3 and He^4 is not understood, since a glib mentioning of the terms Fermi-Dirac or Bose-Einstein statistics does not really constitute an explanation.

From an experimental point of view, one should mention the measurements of H. C. Kramers (Leiden) of the specific heat of liquid helium below 1° K. It turns out that below about 0.65° K the specific heat follows a T^3 law, whereas above 0.65° K the power of T is much higher. It was stated that Landau's theory might explain this behavior.

As a last item of interest, some experiments have been performed on He^6 in Chicago. Because of the short half-life of this isotope the experiments are extremely difficult and as yet far from conclusive, but the first indications are that He^6 shows superfluidity.

We may conclude this report by expressing admiration and gratitude for the organization of the conference and the hospitality shown by our hosts of the Clarendon Laboratory. They hoped to produce a report on the conference within a few weeks so that, at the time the present remarks are published, the complete report will probably already be available.

D. C. Baird
D. ter Haar
H. J. Pain

Department of Natural Philosophy
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Scientists in the News

Wallace M. Alston has been inducted as the third president of Agnes Scott College, succeeding **James R. McCain,** who has been made president emeritus.

Virginia Bartow, of the University of Illinois, has been elected chairman of the American Chemical Society's Division of History of Chemistry. Dr. Bartow succeeds **Henry M. Leicester,** of the College of Physicians and Surgeons, San Francisco. **Alexander Silverman,** of the University of Pittsurgh, was named vice chairman, and **Sidney M. Edelstein,** technical director of the Dexter Chemical Corporation, New York, was re-elected secretary-treasurer.

Harrison S. Brown, of the Institute for Nuclear Studies at the University of Chicago, has accepted appointment as professor of geochemistry in the Division of the Geological Sciences at Caltech. He will join the faculty about Dec. 1. The new appointee won the AAAS $1,000 Prize in 1947 for his work on meteorites, and he was announced, at the American Chemical Society Diamond Jubilee meeting in September, as recipient of the $1,000 ACS Award in Pure Chemistry, to be presented at the ACS spring meeting.

Athletics and faculty-board differences are responsible for recent resignations and replacements at William and Mary College. **Alvin Duke Chandler** has resigned as rear admiral in the Navy to accept the presidency vacated by **John E. Pomfret** in September. Rear Admiral Chandler was, for a time, instructor in physics and electrical engineering at the Naval Academy. His appointment to William and Mary has prompted the resignation of **Nelson Marshall,** dean and professor of biology, with more resignations threatened because of alleged violations of accepted academic practices by the Board of Visitors. Dr. Pomfret has been appointed director of the Henry E. Huntington Library and Art Gallery at San Marino, Calif.

Arthur R. Colwell has been elected president of the American Diabetes Association. He is chairman of the Department of Medicine and Irving S. Cutter Memorial professor of medicine at Northwestern University's Medical School, and chairman of the Division of Medicine of Passavant Memorial Hospital, Chicago. He has served for several years on the council of the diabetes group and is a founder and past president of the Chicago Diabetes Association.

Gustave J. Dammin has been appointed consultant for Laboratories Services to the Health and Special Weapons Defense Division, Federal Civil Defense Administration, Washington, D. C. Dr. Dammin is professor of pathology and head of the Department of Pathology, School of Medicine, Washington University. He is also director of Central Laboratories at Barnes Hospital.

Thomas Bradford Drew, head of the Department of Chemical Engineering at Columbia University, will deliver the third Annual Lecture of the American Institute of Chemical Engineers. Professor Drew will speak on diffusion at the institute's annual meeting in Atlantic City Dec. 3.

Pol Duwez, associate professor of mechanical engineering at Caltech and chief of the Materials Section of the Jet Propulsion Laboratory, has been named by the U. S. Army Ordnance Corps to conduct a five-week mission abroad to study the metallurgy of titanium. Professor Duwez will visit industrial, government, and educational institution research laboratories in England, France, the Netherlands, and Belgium. He left Washington shortly after the meetings of the World Metallurgical Congress in Detroit, Oct. 14–19, where he functioned officially as one of the American conferees.

James D. Ebert, formerly of MIT, has been appointed assistant professor of zoology at Indiana University. Dr. Ebert will develop a program of teaching and research in biochemical embryology.

J. B. Edmonds, professor of horticulture at Mississippi State College, has been invited by the National Organizing Committee of the Thirteenth International Horticultural Congress to present a paper on "Cultural Studies of Sweet Potatoes of Southeastern United States." The congress will meet in London next Sept. 8–15.

Paul S. Epstein, professor of theoretical physics at Caltech, has been named to the American Committee of the International Congress for Cultural Freedom. The congress, headquartered in Paris, is devoting its efforts to fighting totalitarian regimentation—whether neo-Nazi or Communist—of the intellectual pursuits. Besides Dr. Epstein, other American delegates at a recent meeting in Andlau, France, were **Alsoph H.**

Corwin, of The Johns Hopkins University, and **Sidney Hook,** of New York University.

H. Clyde Eyster, research plant physiologist of the Charles F. Kettering Foundation, Yellow Springs, Ohio, will coordinate the photosynthesis research on blue-green algae at both the Ridgeleigh Terrace Laboratory in Dayton and at Antioch College.

Robert T. Gallagher has been named head of the Department of Mining Engineering at Lehigh University, filling the vacancy created by the death of **A. Copeland Callen** in July. He has been a member of the Lehigh faculty since 1942.

Henry Gilman, of the Iowa State College of Mechanical Arts, has won the 1952 Midwest Award of the St. Louis Section of the American Chemical Society. Consisting of an inscribed gold medallion, the Midwest Award is conferred annually on a scientist of the Middle West in recognition of "meritorious contributions to the advancement of pure or applied chemistry or chemical education."

Willard E. Givens, executive secretary of the National Education Association, has received the Save the Children Federation's second annual award for distinguished service to children.

George W. Goddard has been awarded the 1951 Progress Medal of the Photographic Society of America. Colonel Goddard, who is chief of the photographic laboratory of the engineering division at Wright Field AFB, Dayton, received the medal for his contributions to the progress of aerial photography.

Robert Y. Grant has resigned as chief, Mining and Geology Division, Natural Resources Section, General Headquarters, SCAP, and will return to his home in Seattle, Washington.

J. V. Harrison, of the Department of Geology, Oxford University, is visiting professor of geology at the University of Illinois for the academic year 1951–52. He will teach courses in structural and petroleum geology. Until 1938, Dr. Harrison was chief exploration geologist for Anglo-Iranian Oil Company.

Long Island University has appointed **Jacob I. Hartstein,** chairman of the psychology and education departments, director of the university's graduate school. In addition to his post at Long Island University, Dr. Hartstein is dean of the School of Education and Community Administration at Yeshiva University.

Victor S. Hicks has been appointed chief physicist of Tracerlab, to direct the physical research and development projects now being carried on. Prior to joining Tracerlab, Dr. Hicks was employed at Ansco, Binghampton, N. Y., where he had charge of the x-ray research laboratory.

Malvern J. Hiler has been appointed president of The Commonwealth Engineering Company of Ohio. He has served for the past three years as executive vice president.

E. Herndon Hudson has resumed his position as director of the Ohio University Health Service after a year's leave of absence with WHO. During his leave, Dr. Hudson organized a bejel syphilis project in Iraq with headquarters in Baghdad. The project is being continued through cooperation of WHO and the United Nations International Children's Emergency Fund and the Iraq government, under direction of an Iraqi doctor, with **G. W. Csonka** of London as adviser.

At the meeting of the American Academy of Arts and Sciences on Nov. 14, **Herbert Ives** will be presented the Rumford Premium for 1951 and will address the Academy on "Adventures with Standing Light Waves."

Robert W. Keeton, who is retiring as professor and head of the Department of Internal Medicine at the University of Illinois, a position he has held since 1933, was honored at a testimonial dinner given by more than 400 colleagues, former students, and friends. Among the speakers was **Anton J. Carlson,** emeritus professor of physiology at the University of Chicago and former president (1944) of the AAAS.

Lawrence A. Kimpton became chancellor of the University of Chicago at convocation ceremonies that included addresses by J. E. Wallace Sterling, president of Stanford University, and James B. Conant, as well as the conferring of honorary degrees on Detlev W. Bronk, Edwin A. Burtt, Harold F. Cherniss, Robert Maynard Hutchins, William A. Nitze, Arthur M. Schlesinger, and George W. Sherburn.

Chalmer Gatlin Kirkbride, vice president and director of Houdry Process Corp., will receive the 1951 Professional Progress Award in Chemical Engineering, sponsored by Celanese Corporation of America. The award, which carries with it a prize of $1,000, is administered by the American Institute of Chemical Engineers, and will be given at the organization's annual meeting in December. The award is made each year to a technical engineer under 45 years of age, "to recognize outstanding progress in the field of chemical engineering for the betterment of human relations and circumstances."

Arthur Blair Knapp, former vice president of Temple University, has been formally inducted as Denison University's fourteenth president in ceremonies in which Governor Frank J. Lausche welcomed him to his new position.

L. D. Leach, professor of plant pathology, University of California at Davis, is in Denmark on an ECA appointment. He will set up sugar-beet seed decorticating equipment and will work out a sugar-beet disease control program. Dr. Leach will return to the university about Jan. 1.

George V. LeRoy has been appointed associate dean

of the Division of Biological Sciences and associate professor of medicine at the University of Chicago Medical School. Dr. LeRoy supervised the biomedical program of the Eniwetok atomic-weapons test.

Seymour Levine, a former Western Reserve University biophysics instructor, has been named to the faculty of the University of Colorado School of Medicine. Dr. Levine, who has just completed specialized training at the Cooperstown Laboratories in Cooperstown, N. Y., will serve as an instructor in biophysics in the Department of Biophysics.

"Local Cold Injury—Frostbite," a research study by **Robert B. Lewis,** head of the Department of Pathology at the Air Force School of Aviation Medicine, has won for him the 1951 Wellcome Medal and Award given annually by the Association of Military Surgeons of the United States. This prize is awarded annually to the contestant who, in opinion of the association's judges, presents the most useful original investigation in the field of military medicine. In addition to a silver medal and scroll, the Wellcome Award carries a $500 honorarium and the winning paper is published in the *Military Surgeon,* official publication of the AMS.

L. R. Ludwig has been made director of engineering and research for the Westinghouse Electric Corporation's Atomic Power Division at Pittsburgh, succeeding **F. R. Benedict,** who is assuming new engineering responsibilities in the headquarters office of the company. Mr. Ludwig joined Westinghouse following his graduation from the University of Illinois in 1925.

Charles F. McKhann, of Cleveland, has been appointed acting medical director for United Cerebral Palsy. Dr. McKhann will coordinate medical activities in the united attack on cerebral palsy in cooperation with UCP's Research Council, headed by Sidney Farber, of Children's Medical Center and Harvard Medical School, Boston, and the Medical Advisory Committee, of which Winthrop M. Phelps, director of Children's Rehabilitation Institute, of Cockeysville, Md., is chairman.

Thaddeus R. Murroughs will head the new Laboratory of Binocular Seeing, recently established at Northern Illinois College of Optometry. Dr. Murroughs will serve on the teaching staff and will continue work in the Chicago Strabismus Research Project, which he conducted for the past year while director of the research department of the Chicago College of Optometry. The project is sponsored by the Society for Strabismus Research.

Elmer R. Noble has been appointed dean of liberal arts in Santa Barbara College, University of California. **Garrett Hardin** has succeeded him as chairman of the Department of Biological Sciences.

Edward B. Noel, G-E development engineer, received the second annual journal award at the national convention of the Photographic Society of America in Detroit. Mr. Noel, who carries on his scientific work in G-E's lamp development laboratory, Nela Park, Cleveland, was presented a scroll for "the most significant contribution in the technical or scientific fields" for 1950—a paper on "A New Low-Voltage Low-Power Flashtube of High Efficiency," which appeared in the January 1950 issue of *Photographic Science and Technique.* Mr. Noel and **P. B. Davis,** G-E assistant development engineer, are co-authors of the paper.

Gerhard A. Nothmann, assistant chairman of the mechanism and propulsion research department of Armour Research Foundation of Illinois Institute of Technology, has been appointed department chairman. He came to the foundation in 1948 as a research engineer and was appointed assistant supervisor of the mechanisms research section in September 1950, and assistant chairman of the mechanism and propulsion research department in May.

James M. Orten, associate professor of physiological chemistry, Wayne University College of Medicine, was elected secretary of the American Nutrition Association at the annual meeting held in Cleveland.

Winfred Overholser, of St. Elizabeth's Hospital, Washington, D. C., has been named Chevalier in the French National Order of the Legion of Honor for "services rendered to the progress of medical science in the field of psychiatry and for his outstanding contribution to international scientific cooperation." Dr. Overholser served as vice president of the First World Congress of Psychiatry held in Paris in September 1950.

Robert M. Page, superintendent of Radio Division III at the Naval Research Laboratory, has returned from a three-month survey of electronics developments in Germany. He was employed as technical consultant to the Military Security Board, Office of the High Command for Germany.

Walter Orr Roberts, of the High Altitude Observatory of Harvard University and the University of Colorado, Boulder, spent the latter half of October discussing "Unsolved Problems of the Sun's Atmosphere," as a Sigma Xi national lecturer at colleges and universities, and before Sigma Xi clubs in Montana, Idaho, Washington, Oregon, California, and Nevada.

Ernest Sachs, Jr., has been appointed assistant professor of neurosurgery and neurology at Tulane University and is acting chief of neurosurgery at the Charity Hospital, New Orleans.

Rosaltha H. Sanders, biochemist at the Arctic Health Research Center, USPHS, Anchorage, Alaska, has been appointed physiologist in the Creedmoor Institute for Psychobiologic Studies, Creedmoor State Hospital, Queens Village, N. Y.

Adolf Scheibe, chief of the Division of Electricity and Magnetism, Physikalische-Technische Bundesan-

stalt, Braunschweig (British Zone), Germany, recently spent about ten days at the National Bureau of Standards. Dr. Scheibe, who is particularly interested in work on quartz oscillators and their applications, served as acting president of the Physikalische-Technische Bundesanstalt from August 1950 until October of this year. The bureau was also visited recently by **Germano Centola,** director of the Stazione Sperimentale per la Cellulosa, Carta e Fibre Tessili Vegetali ed Artificiali, Milan.

Hubert G. Schenck, for six years chief of the Natural Resources Section, General Headquarters, SCAP, Tokyo, has accepted an appointment as chief, ECA Mission in Formosa.

Daniel S. Trifan, formerly at the University of California, has been appointed head of the chemical section of the plastics laboratory at Princeton University. Dr. Trifan will direct the high polymer research, backed for the past five years by the armed forces.

Robert A. Turner, of the Cornell University Medical College and the University of Massachusetts, has been appointed assistant professor of biochemistry in the College of Medicine, State University of New York, Brooklyn.

Education

Chicago Medical School has received a grant of $2,100 from the Lasdon Foundation for studies of fungus infections, under the direction of David M. Cohen, professor of dermatology and syphilology.

Escuela Interamericana, at Saltillo, Coahuila, Mexico, will begin its winter quarter on Nov. 12. It offers intensive courses in Spanish language and literature and in the history of Mexican civilization. Commercial Spanish, including Gregg shorthand, is also available The school is GI-approved, and prospective students may register in the U. S. through Donald M. Custer, Box 413, Salida, Colo. The summer quarter begins on July 8, 1952.

In schools throughout the state of Illinois, prospective teachers from classes at the **University of Illinois** have begun six weeks of full-time teaching. Each student in the "professional semester" is assigned to an experienced cooperating teacher in his own field after six weeks of work on the campus.

The **Institute on Administration of Scientific Research and Development,** offered by the American University with the cooperation of the AAAS and the National Research Council, has been rescheduled to Nov. 26–Nov. 30. The Institute is offered for persons engaged in research administration. The theme of the 1951 institute will be "Teamwork in Research." Special lecturers from government, industry, and other universities will lead sessions, in addition to staff members of the American University. Information concerning the institute is available from Lowell H. Hattery, 1901 F St., N.W., Washington 6, D. C.

Queens College has recently dedicated a science building, named Ira Remsen Hall in honor of Remsen, first president of the American Chemical Society.

The **University of South Dakota** has added five new members to the staff of the School of Medicine: C. D. Cox, of Pennsylvania State; Amos C. Michael, of Indiana University; and L. F. Michalek, Adaline N. Mather, and Robert Trankle.

Washington University has appointed the following assistant professors of physics: Martin Annis (MIT); Warren B. Cheston (University of Rochester); and Jonathan Townsend (Washington U). Robert N. Varney is on leave at the Bell Telephone Laboratories until next Sept. 1, and Robert D. Sard is at the University of Manchester on a Fulbright fellowship. In the Department of Geology, A. F. Frederickson is doing field work in classic Norwegian localities, with headquarters at the University of Oslo; James C. Brice is spending this semester at Harvard as part of a study (financed by the Ford Foundation) of the experimental programs in general education now being carried on by several large universities; and Betty Kellett Nadeau, micropaleontologist, has resigned; she will be succeeded by Dorothy Jung Echols, formerly a consultant associated with Pond Fork Oil and Gas Company.

The Personnel Research Center at **Wayne University** will conduct for the Department of the Navy a $25,000 year-long search for methods of establishing minimum physical specifications for Navy jobs. Benjamin Epstein, of the Mathematics Department, will direct research for the Navy on statistics related to the life and the fatigue testing of equipment. In the College of Medicine, the Michigan chapter of the Arthritis and Rheumatism Foundation is financing two one-year research projects; the Department of Health has provided funds for continuing support of the postgraduate program in obstetrics and to underwrite a program of coordinated professional training in child growth and development; USPHS grants will support research under the direction of Ernest Gardner, Walter H. Seegers, and Fred L. Rights; and Ciba Pharmaceutical is sponsoring endocrine research under Gordon B. Meyers.

Grants and Fellowships

Nine grants for research totaling $9,065 and ranging in amount from $500 to $1,500 have been made by the **American Academy of Arts and Sciences** from its Permanent Science Fund, and one grant of $500 from its Rumford Fund. Recipients are Forest F. Cleveland, Illinois Institute of Technology; Mark D. Altschule, Harvard Medical School; Henry N. Andrews, Jr., Washington University; Benjamin Karpman, Saint Elizabeths Hospital, Washington, D. C.; Maynard Mosely, University of California at Santa Barbara; Fritz Reder, University of Graz; George H. Scherr, Creighton University School of Medicine, Omaha; Oswald H. Robertson, Stanford University; Charmion Shelby, Library of Congress; and Hans Zinsser, University of Southern California Medical School.

The **Life Insurance Medical Research Fund** invites faculty members to nominate candidates for 1952–53 predoctoral fellowships for research in the medical sciences. These fellowships are open to those who will have completed one year or more of work or graduate school and are in a position to devote at least three quarters of their time to research. Preference is given to those who wish to work on fundamental problems in cardiovascular function. The usual stipend is at the rate of $1,800–$2,200 per annum. Candidates themselves should not apply, but should be nominated by investigators who are willing to sponsor them on the basis of personal knowledge. Closing date for nominations is *Dec. 31.* Further information may be obtained from the Scientific Director of the Fund at 2 E. 103rd St., New York 29.

Lilly Research Laboratories has awarded a grant to Russell R. de Alvarez, professor and executive officer of the Department of Obstetrics and Gynecology at the University of Washington School of Medicine, for continuation of his studies on water and electrolyte metabolism in the toxemias of pregnancy.

Carnegie Institute of Technology has received a $300,000 grant from the **A. W. Mellon Educational and Charitable Trust** to finance permanent Mellon scholarships. Established in 1938, the scholarships have been maintained by yearly grants. Unlike most awards, scholarship requirements are flexible, and if the applicant has shown a desire to help himself, or his need is the result of misfortune, he may be eligible for assistance.

National Distillers Chemical Corporation is sponsoring fellowships at Case Institute of Technology (Melvin J. Astle); University of Cincinnati (Charles E. Frank); Pennsylvania State (N. C. Deno); and Purdue (R. A. Benkeser). **National Distillers Products Corporation** is sponsoring a fellowship at the George Washington Carver Foundation at Tuskegee.

In the Laboratories

Babies Hospital of the Columbia–Presbyterian Medical Center is making a pilot study, supported by a grant from the Metropolitan Life Insurance Company, of accidents among children of school and preschool age, which now constitute the leading cause of death in this country at ages 1 to 19. The survey will be guided by an advisory committee composed of experts in education, psychiatry, epidemiology, pediatrics, accident prevention, and research methods. Rustin McIntosh is chairman of the committee, and William S. Langford is director of the study.

Carnegie Institution of Washington is continuing at Arthur D. Little, Inc., a project for the development of a commercial process for the culture of *Chlorella,* the green, unicellular alga. A pilot plant with a total growing area of 1,200 square feet has been put into operation. Environmental factors that affect the growth rate of *Chlorella* are being studied by several members of the institution's Department of Plant Biology at Palo Alto, Calif., and by J. E. Myers, University of Texas, a fellow of the institution. In a separate phase of the program, R. W. Krauss, University of Maryland, another institution fellow, is culturing a large variety of different species of algae.

The **Communicable Disease Center Technical Development Services Laboratories** have added George W. Pearce and Henry R. Krakauer to their staff. Dr. Pearce has been associated with the New York State Experiment Station, and Dr. Krakauer with Montefiore Hospital, New York.

Consolidated Vultee Aircraft Corporation has begun the construction of a mass-production plant for guided missiles, a Navy Ordnance facility, at Pomona, Calif. Pending occupancy of the Pomona plant approximately a year from now, the Guided Missile Division is operating in San Diego. First production project is an antiaircraft missile designed for shipboard or land launching. Among the personnel recently added to the division to expedite work on this project are C. R. Irvine, who will function as assistant division manager and chief engineer, and Harold W. Pope, assistant chief engineer.

General Aniline and Film Corporation has created two new executive posts in carrying out expansion plans. Cary W. Wagner has been elected vice president, and John C. Franklin vice president of operations for the company's dyestuffs and chemical division. Mr. Franklin was formerly manager of the AEC Oak Ridge operations.

Under the direction of Forrest F. Cleveland and Arnold G. Meister, **Illinois Institute of Technology** will continue its work on the molecular structure and thermodynamic properties of various chemical compounds, particularly methane and ethane. A contract awarded by the U. S. Office of Ordnance Research will support the program.

International Nickel Company of Canada has completed a new shaft and concentrator at its Creighton mines, bringing to a total of 13 the number of shafts operating in the Sudbury District. The new mill is part of a $100,000,000 program of underground mine development expected to be completed in 1953.

Roscoe B. Jackson Memorial Laboratory has appointed an Advisory Committee composed of Frank Beach, chairman, Leonard Carmichael, Howard S. Liddell, Donald O. Hebb, and Theodore C. Schneirla. The members of the committee will function as consultants in the laboratory's program of research on the genetics of animal behavior.

Harold C. Weingartner has been elected vice president and general manager of the Equipment Division of **National Research Corporation,** and James L. Vaughan has been appointed director of the Process Engineering Department. Mr. Weingartner has been chief engineer since 1946, and Mr. Vaughan has been design and development engineer for Rohm & Haas since 1947. National Research will build additional plant facilities in Newton, Mass., to be occupied by its Equipment Division next spring.

Meetings and Elections

Susan B. Riley, of George Peabody College for Teachers, has been elected president of the **American Association of University Women**; Louise Troxel was re-elected vice president, and Mrs. Arthur J. White was re-elected treasurer. Lucy S. Howorth was elected second vice president, and Mrs. Charles S. Bluemel, secretary.

The **American Institute of Electrical Engineers** and the **Institute of Radio Engineers** are sponsoring the first conference held specifically to review accomplishments in the field of large-scale computer engineering. Sessions will be held Dec. 10–12 in the Benjamin Franklin Hotel, Philadelphia, and in the Edison Building Dec. 11. The program is being directed by a committee under John C. McPherson, International Business Machines Corporation. The proceedings of the conference will be published shortly after the meeting.

The **American Society of Human Genetics** has elected F. J. Kallmann president for 1952, and C. H. Danforth vice president. S. C. Reed was elected secretary, and C. N. Herndon treasurer.

Harry G. Armstrong, Air Force surgeon general, has been elected president of the **Association of Military Surgeons**, succeeding Robert C. Cook. Winchell McK. Craig, of the Mayo Clinic, was elected first vice president and will succeed to the presidency next year.

The second **Thomas Alva Edison Foundation Institute for Science Teachers** will be held Nov. 12–13 at Glenmont, Mr. Edison's former home near West Orange, N. J. Sixty representatives of school administrators, guidance counsellors, science, mathematics, English, and social studies teachers, students, parent-teacher groups, and boards of education will attend the meeting, which will center on the theme "The Dependence of Western Civilization on American Industry and the Critical Shortage of Engineering and Scientific Manpower."

The **Paleontological Research Institution** has elected Kenneth E. Caster president, Katherine Van Winkle Palmer vice president, Gilbert D. Harris treasurer, Rebecca S. Harris secretary, Gilbert D. Harris director, and Edward Marks curator.

Recent Deaths

Charles H. Adams (83), astronomer, San Francisco, Aug. 8; **Ruth M. Addoms** (55), botanist, Durham, N. C.; **A. J. Allmand** (66), chemist, London, Aug. 11; **George W. Booth** (80), civil engineer, Lebanon Township, N. J., Oct. 1; **Lucien Bovet** (—), psychiatrist, Geneva, Switzerland, July 23; **Adolph Bregman** (61), consulting engineer, New York, Oct. 4; **Carl J. Bucher** (61), pathologist, Philadelphia, Oct. 9; **Walter M. Buswell** (85), botanist, Coral Gables, Fla., Sept. 29; **Hans Cloos** (—), geologist, Bonn, Germany, Sept. 26; **W. A. Cogshall** (77), astronomer, Rockford, Ill., Oct. 5; **Aubrey J. Collins** (76), pediatrician, Boston, Oct. 3; **Robert J. Cook** (63), orthopedic surgeon, New Haven, Conn., Oct. 4; **Parker M. Cort** (73), physician, Northampton, Mass., Sept. 27; **Robert E. Denike** (69), electrical engineer, Short Hills, N. J., Sept. 28; **Myron H. Detrick** (89), engineer, Jackson, Mich., Sept. 24; **J. Russell Doubman** (57), marketing expert, Philadelphia, Oct. 13; **Steven F. Evelyn** (67), consulting engineer, Westfield, Mass., Sept. 27; **Joseph Fleitas** (63), physician, Philadelphia, Sept. 24.

H. Galliard (—), parasitologist, Paris, July 7; **Lawrence H. Gerson** (63), industrial chemist, Cleveland, Oct. 2; **Donald Goodchild**, of Washington, D. C. (54), member administrative staff, American Council of Learned Societies, Middlebury, Vt., Sept. 27; **J. Howard Graham** (71), organic chemist, Philadelphia, Oct. 5; **George L. Haas** (75), optical instruments expert, New York, Sept. 26; **Edwin W. Hammer** (83), electrical engineer, Montclair, N. J., Oct. 11; **Albert G. Heller, Sr.** (67), podiatrist, Elizabeth, N. J., Oct. 1; **Edward F. Herschede**, of Cincinnati (70), gemologist, Toronto, Sept. 27; **Harold M. Horton** (65), mathematician, New Milford, Conn., Sept. 25; **Augustus Houghton** (72), technological editor, New York, Sept. 24; **Jens Jensen** (91), landscape expert, Ellison Bay, Wis., Oct. 1; **Chris Kaiser** (72), electrical engineer, New York, Sept. 29; **Joseph Kempfner** (54), ear, nose, and throat specialist, New York, Oct. 1; **Joseph H. Kerrick** (58), mining engineer, Philadelphia, Sept. 25; **Herman L. Kretschmer** (72), urologist and past president, American Medical Association, Chicago, Sept. 23; **Oliver C. Lester** (77), physicist, Boulder, Colo., Sept. 28; **Mark C. Lewis** (56), electrical engineer, Summit, N. J., Sept. 27.

William H. Martin (51), electrical engineer, Rahway, N. J., Oct. 3; **Robert J. May** (71), radiologist, Cleveland, Oct. 17; **Otto F. Meyerhof** (67), biochemist, Philadelphia, Oct. 6; **Harry F. Miter** (74), engineer, Cleveland, Oct. 5; **Bernard E. Mulligan** (81), health officer, Yonkers, N. Y., Sept. 23; **Hugo Newman** (84), educator, New York, Oct. 16; **Charles L. Poor** (85), astronomer, New York, Sept. 27; **Woodruff L. Post** (77), physician and surgeon, New York, Oct. 10; **Willett F. Ramsdell** (60), authority on forest conservation, Ann Arbor, Mich., Sept. 29; **William E. Ridenour** (78), chemist, Philadelphia, Oct. 16; **Walter E. Rogers** (61), botanist and ornithologist, Appleton, Wis., Oct. 5; **Frederick F. Shelden** (38), zoologist, Los Angeles, Sept. 2; **Murray Slotnick** (24), physicist, Ann Arbor, Oct. 5; **Raymond Squier**, of Greenwich, Conn. (52), gynecologist, New York, Sept. 17; **Calvin Sterling** (49), chemist, Plainfield, N. J., Oct. 1; **Lucien B. Stone** (60), mechanical engineer, Newark, N. J., Oct. 2; **Roland R. Tileston** (65), physicist, Pasadena, Sept. 18; **Arnold D. Tuttle** (71), physician, Chicago, Oct. 6; **Edward S. Welch** (82), horticulturist, Shenandoah, Ia., Sept. 22; **DeWitt G. Wilcox** (94), surgeon, Newton, Mass., Sept. 26; **Alfreda B. Withington** (91); physician, Pittsfield, Mass., Oct. 1; **Lynne K. Wood** (36), chemist, Lexington, Ky., Oct. 2; **Joseph J. Zimmerman** (36), internist, Philadelphia, Oct. 11; **Julio Zuluaga** (79), physician and surgeon, Manizales, Colombia, Oct. 2.

Description:

1. In order to compare the output wave form of three different line voltage regulators, a DuMont Type 304-H oscillograph was connected to the output of each in turn. Regulators A and B were loaded with 250 watts while Regulator C was loaded by an additional 550 watts, since it is rated for much greater loads.

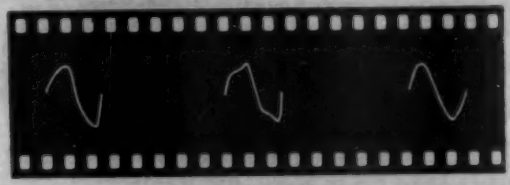
2. Each of the wave forms was recorded with an oscillograph record camera.

3. The RC filters of Figure 1 were connected between the regulator outputs and the CRO Y input and the wave forms were again recorded for comparison.

Figure 1

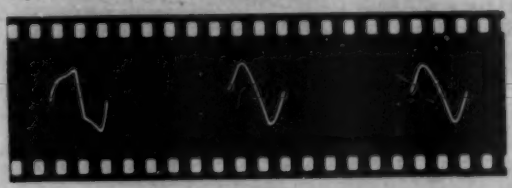
Results:

Fig. 2 shows the signal waveform of output of three different line regulators without external filter displayed on a DuMont Type 304-H.



Voltage Regulator A Voltage Regulator B Voltage Regulator C

Fig. 3. Improvement of output wave form of Regulator B using filters of Fig. 1.



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Cots added to a room are $2.50 each; dormitory style rooms (for 5 or more) are $3.50 per person.

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Meetings & Conferences

Nov. 12–14. National Fertilizer Association (Fall). Atlanta Biltmore Hotel, Atlanta.

Nov. 12–15. Association of Land-Grant Colleges and Universities. Rice Hotel, Houston, Texas.

Nov. 12–15. National Electrical Manufacturers Association. Chalfonte-Haddon Hall, Atlantic City.

Nov. 12–16. Gulf and Caribbean Fisheries Institute. Sans Souci Hotel, Miami Beach.

Nov. 14–15. Industrial Hygiene Foundation (Annual). Mellon Institute, Pittsburgh.

Nov. 15. American Society for Engineering Education (Fall). Rice Hotel, Houston, Texas.

Nov. 15–16. American Council of Commercial Laboratories. Baker Hotel, Dallas, Texas.

Nov. 15–17. American Anthropological Association (Annual). Palmer House, Chicago.

Nov. 15–17. Rocky Mountain Oil and Gas Association (Annual). Cosmopolitan Hotel, Denver.

Nov. 19–20. Society of Exploration Geophysicists, Midwest regional (Annual). Baker Hotel, Dallas.

Nov. 22–24. Central Association of Science and Mathematics Teachers (Annual). Hollenden Hotel, Cleveland.

Nov. 25–Dec. 1. Congrès International de Chimie Industrielle. Paris.

Nov. 26–30. American Society of Mechanical Engineers (Annual). Chalfonte-Haddon Hall, Atlantic City.

Nov. 26–30. Institute on Administration of Scientific Research and Development (sponsored by AAAS and National Research Council). American University, Washington, D. C.

Nov. 26–Dec. 1. Exposition of Chemical Industries. Grand Central Palace, New York.

Nov. 27–28. American Institute of Architects and Atomic Energy Commission Conference on Laboratory Design for Handling Radioactive Materials. National Academy of Sciences, Washington.

Nov. 28–30. Scientific Apparatus Makers Association (Midyear). Hotel New Yorker, New York.

Nov. 28–30. Western Forestry and Conservation Association (Annual). Multnomah Hotel, Portland, Ore.

Nov. 29–30. Animal Care Panel. Northwestern University, Chicago.

Nov. 29–30. Pittsburgh Diffraction Conference (Annual). Mellon Institute, Pittsburgh.

Nov. 30. Scientific Research Society of America (RESA). National Academy of Sciences, Washington, D. C.

Nov. 30–Dec. 1. American Physical Society. Rice Institute, Houston.

Dec. 2. American Academy of Dental Medicine (Midwinter). Hotel Statler, New York.

Dec. 2–3. American College of Chest Physicians (Interim Session). Ambassador Hotel, Los Angeles.

Dec. 2–5. American Institute of Chemical Engineers (Annual). Chalfonte-Haddon Hall, Atlantic City.

Dec. 2–5. American Society of Refrigerating Engineers (Annual). Hotel Roosevelt, New York.

Dec. 2–5. Vegetable Growers Association of America (Annual). Marlborough-Blenheim Hotel, Atlantic City.

Dec. 5–8. Philippine College of Surgeons (Annual). Philippine General Hospital, Manila.

Dec. 6. American Psychoanalytic Association (Midwinter). Hotel Waldorf-Astoria, New York.

Dec. 6. Society of Cosmetic Chemists (Annual). Biltmore Hotel, New York.

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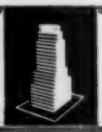

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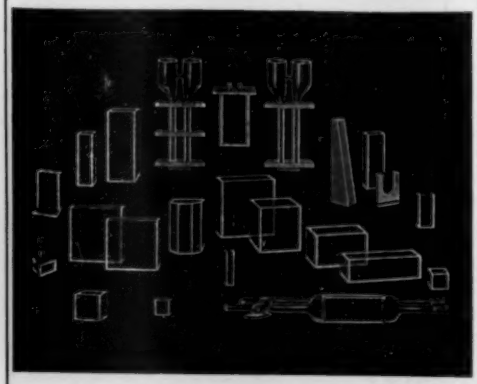

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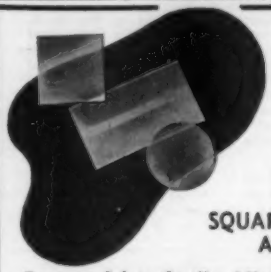

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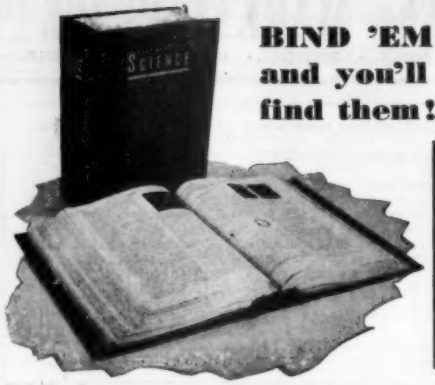

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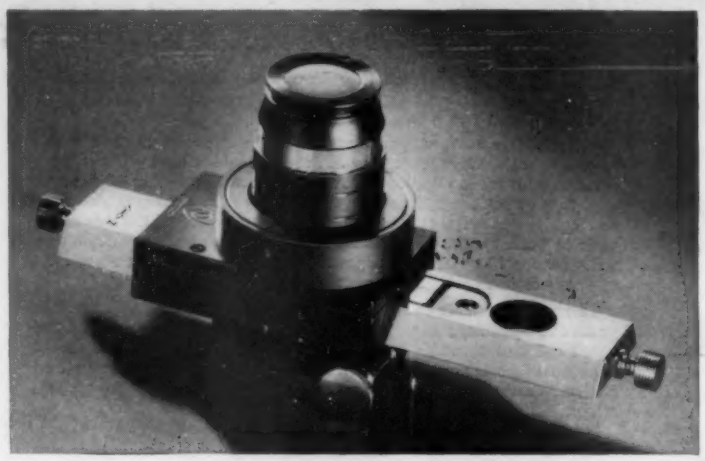

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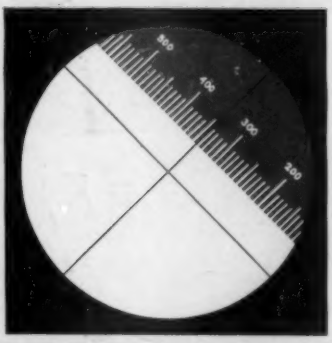

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